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ABSTRACT

Middle school and high school students need to develop many skills in order to investigate environmental issues and know the basics of citizenship action strategies. This student guide is designed to teach students how to investigate and evaluate environmental issues and actions. The guide is presented in six modules. Module 1 introduces the concept of environmental problem solving through activities in which the students examine the definition of the term environment, the effects of environmental interactions, pictorial illustrations of environmental issues, environmental beliefs and values, and the basics of issue analysis. Module 2 gives students the skills to collect information needed to investigate an environmental issue. Students learn to identify an issue, formulate research questions, compare information resources, identify resource people, summarize information, and search for references. Module 3 introduces students to the use of surveys, questionnaires, and opinionnaires. Students study the rules governing the use of surveys and questionnaires, learn to distinguish between the three research methods, learn the rules of sampling populations, and summarize data collection techniques. Module 4 helps students understand basic types of data interpretation. Module 5 provides students with activities that lead the students through the investigation of an environmental issue of their choice. Module 6 provides students with the skills to become active participants in solving environmental issues. A teacher's edition is appended to the book. It provides suggestions for teaching the exercises associated with each module. (MDH)

ED 368 557

Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules

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A Curriculum Development Project Designed to Teach Students How to Investigate and Evaluate Science-Related Social Issues

Harold R. Hungerford - Ralph A. Litherland - R. Ben Peyton
John M. Ramsey - Trudi L. Volk

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INVESTIGATING AND EVALUATING ENVIRONMENTAL ISSUES AND ACTIONS: SKILL DEVELOPMENT MODULES

A Curriculum Development Project Designed to Teach Learners How to Investigate and Evaluate Environmental Issues

SIX MODULES

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Acknowledgments

This set of modules represents a substantial departure from typical models for environmental education or STS education. Because of this, no definite guidelines existed to guide the developers in the production of a program that met their goal - one that would help middle and senior high school learners become autonomous investigators of environmental issues and teach them the basics of citizenship action strategies. This circumstance resulted in a development phase that lasted over a decade during which five editions of this program were produced and evaluated.

A project of this kind necessitates the involvement of many skills. Many were those who gave both time and energy willingly in an effort to help the developers reach their goals. Trial teaching efforts of Floyd Waggoner, Larry Tate , R. Henry Bisaga, and Donna Childers contributed measurably to an evaluation of earlier editions. Equally important were the suggestions given by Drs. John Disinger and Tom Tanner with respect to the action component of this program.

Dr. J. Ronald Gardella contributed both his artistic talents and his educational expertise as he supervised the trial teaching of an earlier edition in New Jersey middle schools. Also providing art work for Module IV was Suzanne Hungerford. And, many thanks go to Pam Isner for her cartoons which can be found throughout this edition.

Several research studies were conducted to measure the effectiveness of the program for generating both knowledge and skills. Floyd Waggoner, John Ramsey, and Gary Klingler invested heavily in these efforts. Dr. William Bluhm was also involved in data collection and interpretation and his efforts contributed greatly to the success of these studies.

These research studies, coupled with support from the National Science Foundation and the National Diffusion Network as well as the National Training Network headed by Stephanie Hendee, have given this program a great deal of national visibility. Because of this, thousands of learners are involved with this curriculum who would not have otherwise been a part of it.

The authors would also like to acknowledge the late Audrey Tomera whose contributions to earlier versions of the Teacher's Edition help shape the overall character of the product. Certainly, her efforts were, and are, greatly appreciated and she is remembered affectionately and respectfully by all of those involved in this project.

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To all of the above, and many others, the authors owe a sincere debt of gratitude. Without their help this program would not be available.

The Authors - June, 1992

PREFACE

To The Student

Many students are worried about problems in the environment. Perhaps you are one of them. You might be worried because you know that you are part of the environment. Since the environment is all around you and you are part of it, it is very important to you. You can't get along without air to breathe. You need food to eat and water to drink. You need clothes to wear and somewhere to live.

Maybe you have gotten the idea that this just isn't enough. You may think that the air and water should really be clean. The food should be safe to eat and it should taste good. The house or apartment should be a safe and happy place. Yes, maybe there even ought to be a tree close by and a squirrel to watch and an owl to listen to at night. Some students are also worried about what the environment will be like when their children are growing up. How do **you** feel about these things?

If you are worried about the future of the Earth, you are not alone. Many people are alarmed about problems in the environment. Lester Brown is one of these people. He got a group of people together to study the environment, its problems, and what can be done to help. The group is called the Worldwatch Institute. In 1984, these men and women started publishing a yearly "report card" called **State of the World.** The first report card gave us a scary, but honest, picture of the environment and its problems. It named soil, energy, and population as three big problems. The report also said that unless something is done, time will run out for millions of people.

The number of people on Earth is over 5,000,000,000. The world's population of human beings has almost doubled in the last thirty years. That spells trouble! As the Earth's population has gotten larger, the earth's resources have gotten scarcer. Forestslands are becoming fewer. The ocean's fish catch is getting smaller. Important animals and plants are becoming extinct. Grasslands are becoming poorer. Farm soils are eroding away and there are fewer fields to cultivate for growing food. What we have is a growing population which needs more and more water, food, and shelter. We also have shrinking resources. There is simply less to go around. We already see many cases of crowding, severe food shortages, fuel scarcity, and poorer living conditions. Unless something is done to bring about a balance between human needs and available resources, the future is gloomy!

At this point you may be asking yourself, "Why are they telling me this?" We are not out to frighten you, but we do want you to understand just how serious the situation is. Probably the most important message for you to get is that things in the environment are not good. And, they will get worse unless we do something . . . and do it soon!

What can you do? The Earth's environmental problems are big and serious. Sometimes it is hard to see what you can do to help solve them. But, there are many things that you can do.

The hope for a better environment depends upon the world's citizens. Who are these citizens? You are one of them. You are both a citizen of your country and of the world. You, then, are a part of the hope for a better environment.

The authors' goal in this book is to help you become a concerned and responsible citizen. They think that you are already interested in the environment and want to learn more about solving its problems. They are sure you can do it. Are you ready to begin?

"Suppose the environment is trying to tell us something? The planet seems to have problems with species diversity, the rain forests, the ozone layer, wetlands conservation, ocean pollution, land-use management, human population numbers, energy consumption, waste disposal and more! Is it time we took the environment seriously?"

MODULE I

ENVIRONMENTAL PROBLEM SOLVING

Introduction

Each one of us is part of the environment. We are also a part of its problems. Module I should help give you a better understanding of the environment and the ways in which you interact with it.

In Module I you should also learn about a number of environmental problems and issues. You will be asked to learn about beliefs and values, and the part they play in creating and solving environmental issues. And, you will get a chance to decide where you stand on certain issues.

Learning objectives for Module I can be found on the next page. They will tell you exactly what will be expected of you. Always read the objectives carefully before beginning work on a module.

Objectives for Module I

Upon completion of Module I you will be expected to be able to . . .

1. ...define "environment".
2. ...apply the term "interaction" when writing about or discussing the environment, an environmental problem, or an environmental issue.
3. ...describe how human activities impact on the environment.
4. ...analyze an environmental problem and name the ways in which that problem affects both human beings and the environment.
5. ...explain how a lessening of the quality of the environment eventually lessens the quality of human (your) life.
6. ...identify both environmental problems and environmental issues.
7. ...define "beliefs".
8. ...define "values".
9. ...explain how a person's beliefs influence his/her position on an issue.
10. ...explain why you consider a particular environmental situation to fit into the "issue" category.
11. ...analyze environmental issues and identify the "players", the beliefs, and the values that are associated with that issue.
12. ...explain why it is difficult to resolve an environmental issue when there are strong and differing value positions surrounding it.

The Environment

"Environment" is a word that you often hear. Do you know what it means? What is the environment? In the space below, write your definition for environment.

(I-1) My definition for "environment":

_____

_____

_____

_____

Your instructor may ask several students to read their definitions. While this is being done, think carefully about these definitions. How are they alike and how are they different? Also, try to decide whether you think they are accurate. Below is a list of questions for you to think about as the definitions are read.

1. How many students identified or described things (factors) in school, in the community, or in the region as part of the environment?
2. How many students said that everything around them was part of the environment?
3. How many students included the ways humans affect, or are affected by, things around them?

One of the really important factors in an organism's environment is the interaction between the organism and things around it. Interactions deal with how living things affect each other.

Many interactions between you and your environment are complex. Suppose you go to your favorite fast food outlet and buy a hamburger. What are the interactions between you and your environment here? First of all, an animal was killed to produce the hamburger meat for you. The animal had to be grown and processed, and all of this takes energy. The meat had to be cooked. This used up either oil or coal to produce the energy. The paper wrappings in which the food came were produced from trees. Trees had to be felled and processed. More energy! After eating the food, you put heat and carbon dioxide back into the environment. And, what happened to the waste materials you threw away in the trash as you left the restaurant?

These are only some of the interactions which take place when you buy and eat that hamburger. But, you should begin to get the picture. Every time you use a resource from the environment, you are interacting with it in some way. And every interaction affects both you and the environment.

It might be a good idea to take some time and look closely at a part of your resource use. Hopefully, an investigation such as this will give you a better idea of how you interact with the environment.

Just One Example of You and Interactions

You have already seen that you interact with the environment through eating. Eating is something that we do almost every day of our lives. It gives us the energy we need to stay alive. It also usually gives us a good deal of pleasure. We can easily see how we are affected by eating. But, have you ever really stopped to think how the environment is affected? Few people have thought about this.

What if you had eaten a piece of toast this morning? Let's look at a few of the environmental effects connected with that one piece of toast. That may not be quite as simple as it first appears. We'll start by focusing on the slice of bread.

The bread was made from flour which came from grain. That grain was probably planted, cultivated, and harvested on a farm in the United States. Many resources were used between the farm and your breakfast table. In other words, many environmental interactions took place. There is a diagram on the following pages which shows you some of these interactions. These interactions start on the farm. Try to identify and describe as many environmental interactions as you can from this diagram.

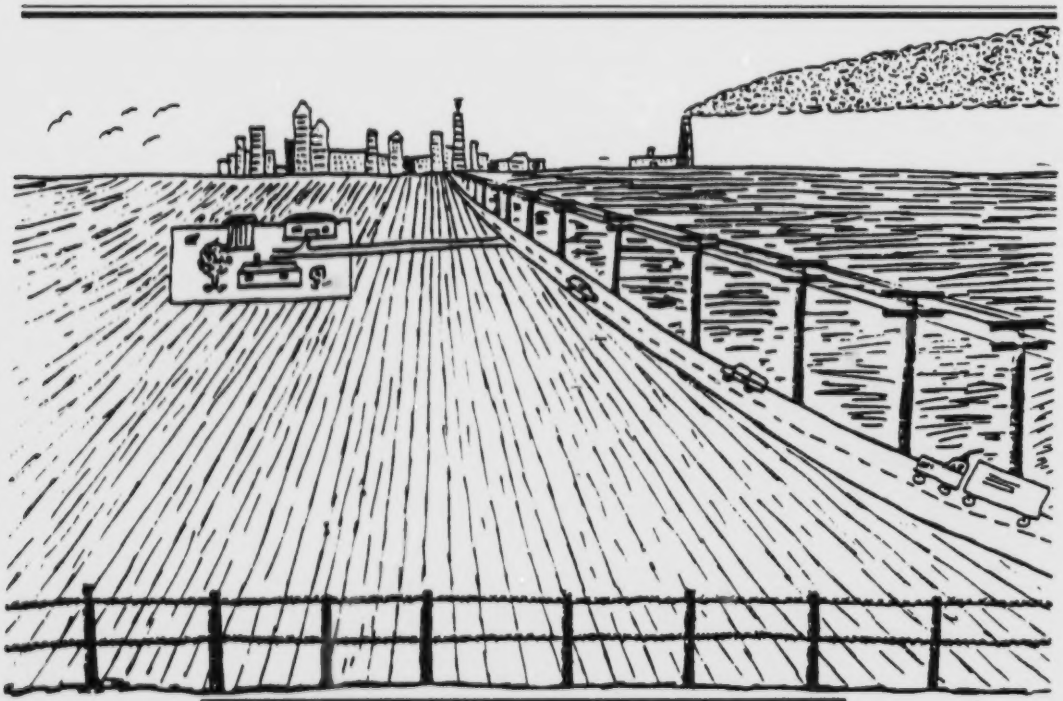
It hardly seems possible that a single piece of toast could be connected with so many environmental interactions. And yet, a slice of toast is a small part of what you eat each and every day. Think of your many interactions with the environment by the time you eat that late night snack tonight. A wise man once said, "You can never do just one thing." That certainly appears to be true. Your simple action of eating a piece of toast affects the environment in many ways!

Before you go further, it would be a good idea to think about how our actions affect the environment. Let's take that piece of toast. Just what effect did it have on the environment? (I-2)

That Piece of Toast - Environmental Effects

Below, you will find a summary of some of the steps involved in the production of that piece of toast. Also, you will find a list of some of the resources consumed. Please study this summary chart and then do the things asked below:

Some Steps Involved	Resources Consumed
1. Cultivation of land for growing cereal grains.	Petroleum; top soil
2. Increasing yields using chemical fertilizers and pesticides.	Petroleum
3. Harvesting cereal grains.	Petroleum
4. Transporting, storing, and processing grain.	Petroleum; coal
5. Baking and packaging bread commercially.	Petroleum; natural gas
6. Transporting and shelving bread in stores.	Petroleum; coal
7. Transporting bread to the home.	Petroleum
8. Toasting the bread.	Petroleum; coal



AMERICA'S PRIME FARMLAND FOR SALE

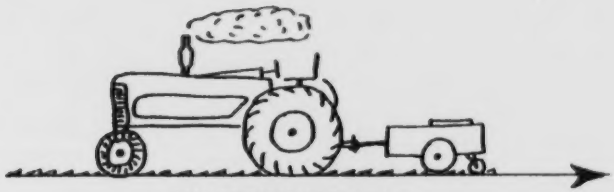
FOR SUBDIVISIONS, SHOPPING MALLS, ROADS, INDUSTRIAL PARKS

AIRPORTS, GOLF COURSES, GARBAGE DUMPS

THAT PIECE OF TOAST

From Wheat Field To Table

(Energy/Resource Costs)

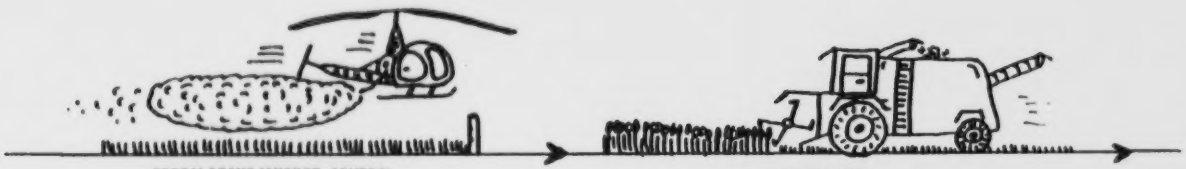


SOIL PREPARATION/PLANTING

Petroleum Products

Motor Oil
Gasoline
Diesel Fuel
Grease

(INTERACTIONS ???)



FERTILIZING/INSECT CONTROL

Petroleum Products

Aircraft Fuel
Chemical Fertilizers
Chemical Pesticides

(INTERACTIONS ???)

HARVESTING

Petroleum Products

Motor Oil
Gasoline
Diesel Fuel
Grease

(INTERACTIONS ???)

TRANSPORT TO ELEVATOR & STORAGE

Petroleum Products

Motor Oil
Diesel Fuel
Grease

Coal or Petroleum

Electricity

(INTERACTIONS ???)

TRANSPORT TO PROCESSING MILL

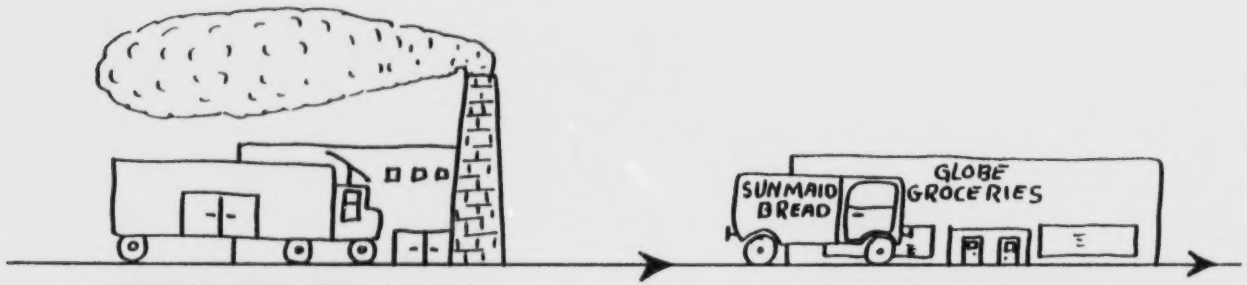
Petroleum Products

Diesel Fuel

Coal or Petroleum

Electricity

(INTERACTIONS ???)



TRANSPORT TO BAKERY, BAKING, & PACKAGING

Petroleum Products

Motor Oil
Diesel Fuel
Grease
Natural Gas

(INTERACTIONS ???)

TRANSPORT TO STORE/SHELVING

Petroleum Products

Motor Oil
Gasoline
Grease
Natural Gas

Coal or Petroleum

Electricity

(INTERACTIONS ???)

PURCHASE & TRANSPORT HOME

Petroleum Products

Motor Oil
Gasoline

(INTERACTIONS ???)

TOASTING

Coal or Petroleum

Electricity

(INTERACTIONS ???)

1. Write a list of the possible environmental effects that go along with using soil, petroleum, natural gas, and coal.

2. Write a short paragraph which tells whether or not you think these environmental impacts are important. Please explain your decision.

3. Many human beings do not realize that resource use is usually a two-way street. When we are benefited by something like a piece of toast, the environment can be impacted heavily. Take a few moments to think it through and then write a short paragraph which would attempt to convince someone that human benefit and resource use is a two-way street.

Summary of Environmental Interactions

We've spent a good deal of time studying how you interact with the environment. We've done so because the idea of environmental interaction is so important. In our discussion we've looked at two sides of environmental interactions. We've looked at the effects on you and the effects on the environment. It's time now to try to pull all of this together. Let's see what it all means.

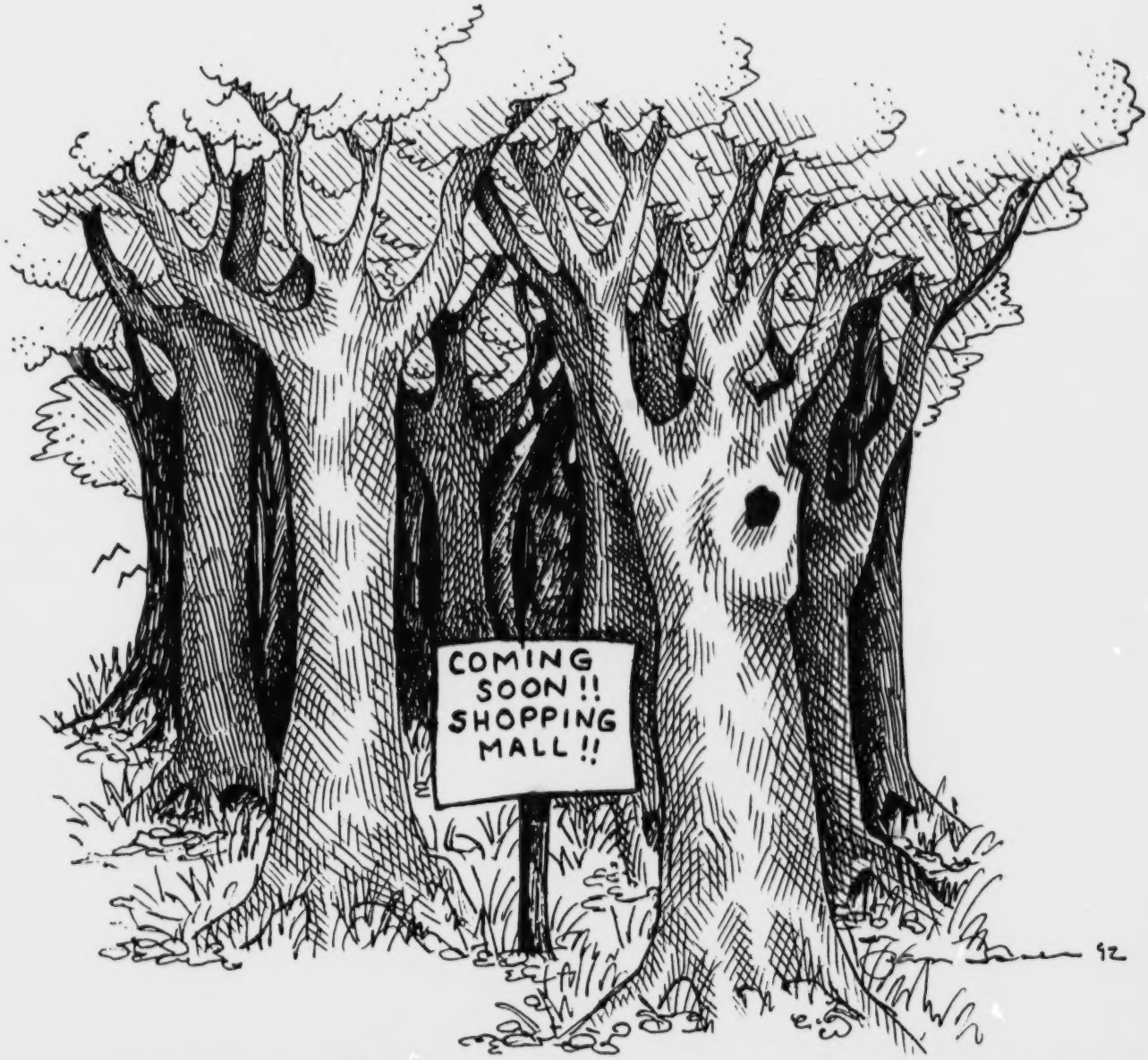
We've said before that the interactions that occur between an organism and its environment are very important. We hope that two big ideas have occurred to you. The first idea is that **humans interact with the environment, directly and indirectly, in many ways.** We are totally dependent on our environment. Many of the "simple" things we do daily (like eating a hamburger or a piece of toast) are closely linked to the environment.

The other big idea also has to do with those interactions. Think back on the environmental interactions connected with a piece of toast. Pay special attention to the ways that using resources affects humans. Now, look at how resource use affects the environment. Are humans gaining benefits from those interactions? What about the environment? Is the environment gaining benefits from those interactions? Thus, **improving the quality of human living can result in lessening the quality of the environment.**

Many of the environmental interactions that make our lives more comfortable tend to degrade or harm the environment. Often, improving the quality of human living results in lessening the quality of the environment. Many people are concerned about this imbalance. They desire a comfortable living for themselves. At the same time, they desire a clean and healthy environment. Some people argue that the quality of life and the quality of the environment are not at all separate, but are closely linked. They even suggest that lessening the quality of the environment will eventually lessen the quality of our lives. They say it will also threaten the lives of future generations. Think about this for a minute. Why might it be true? (I-3)

Why might this be true?

Environmental interactions are much more complex than they first appear. Understanding this idea is an important step to understanding what "environment" means. So, let's come back to that question. Just what is meant by **environment**? We think that your ideas about "environment" might have changed since we first asked that question. We'd like you to write a definition or description of "environment" on a separate sheet of paper. This could be turned in to your instructor. That way, he/she can see how well you understand this term. Afterward, your teacher may ask your help in putting together a class definition. That definition can be posted in the classroom as a permanent reference. (I-4)



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Environmental Problems

By now, you have an idea about what the environment includes. We'd like you to start thinking about ideas connected with environmental problems and issues. First of all, can you name several problems in the environment? We've listed three for you. Try to name four more. If you are still having trouble after a few minutes, talk with your teacher. For now, ignore the "Issues" column. We'll come back to that later. (I-5)

My List of Environmental Problems:

Example: Soil erosion due to poor farming practices.
Example: Declining duck populations due to the drainage of wetlands.
Example: Ground water pollution from toxic waste dumps.

My Choice of a Problem	Issue
1.	
2.	
3.	
4.	

How did you decide what to list as an environmental problem? It might help you to know that environmental problems are related to man, the environment, and interactions between the two. An environmental problem also presents a difficulty of sorts. For example, a volcano erupting, an earthquake, and a flood are all natural events. These events are not considered to be environmental problems. But what if the volcanic eruption, the earthquake, or the flood threatened some part of man's physical or economic well-being? What if it lessened the quality of life in some way? Then we might say that the event resulted in an environmental problem.

How might an event threaten human well-being or lessen the quality of the environment? Perhaps a volcanic eruption might change atmospheric conditions and weather patterns. Maybe the flood could destroy human lives and homes. Or, perhaps an earthquake could cause buildings to collapse and water and gas pipes to break. All of these could be considered to be environmental problems.

Let's see how a specific event resulted in a number of environmental problems. The event we'll look at is the eruption of Mount St. Helens. Mount St. Helens is a volcano located in the state of Washington. For years, the volcano was inactive. People built their homes near its slopes. Wildlife was abundant and wilderness areas were set aside for preservation and recreation. Lumbering companies studied the possibilities of cutting trees from its slopes. Suddenly, Mount St. Helens rumbled to life in 1980.

Following the Mount St. Helens eruption, a number of environmental problems were obvious:

1. Many animals, including large numbers of elk, were killed.
2. Hundreds of acres of timber were levelled by the blast.
3. Volcanic ash deposits disrupted activity in both urban and agricultural settings.
4. Human life was lost.
5. Areas used for recreation were considered dangerous and were closed to the public.
6. There were changes in stream flow and drainage patterns.

All of the above could be considered environmental problems. They involved man, the environment, and interactions between the two. They also threatened some aspect of human well-being.

Environmental Issues - Beyond Problems

Now that you know what an environmental problem is, let's look at issues. An issue is a matter about which two or more parties cannot agree. In many cases, environmental problems remained unsolved because people (or groups of people) cannot agree on how to solve the problem. We usually call these disagreements environmental issues. Such a disagreement occurred between lumber companies and a group of citizens after the eruption of Mount St. Helens.

The force of the Mount St. Helens eruption blew down hundreds of acres of timber. The lumber companies believed that the timber was going to waste. They also felt that it would be profitable to collect and process the fallen trees. A group of citizens disagreed. They argued that the trees should be left on the ground. They believed that the decaying timber would provide nutrients to the area. In this way the area would restore itself much sooner than if the trees were removed.

Both of these groups were aware of the environmental problem . . . that there were hundreds of acres of fallen timber because of the eruption. But, they disagreed over what should be done with those trees. Thus, they disagreed over the solution to the problem. The lumber companies and the citizen groups held different points of view regarding the fallen trees. When a person has a point of view about something, we call that a position. People may take different positions on environmental issues. And, their positions will probably differ because they represent different beliefs and values. These beliefs and values will influence the solutions that people choose.

The eruption of Mount St. Helens, photographed May 18, 1980.
Photo courtesy of United States Geological Survey

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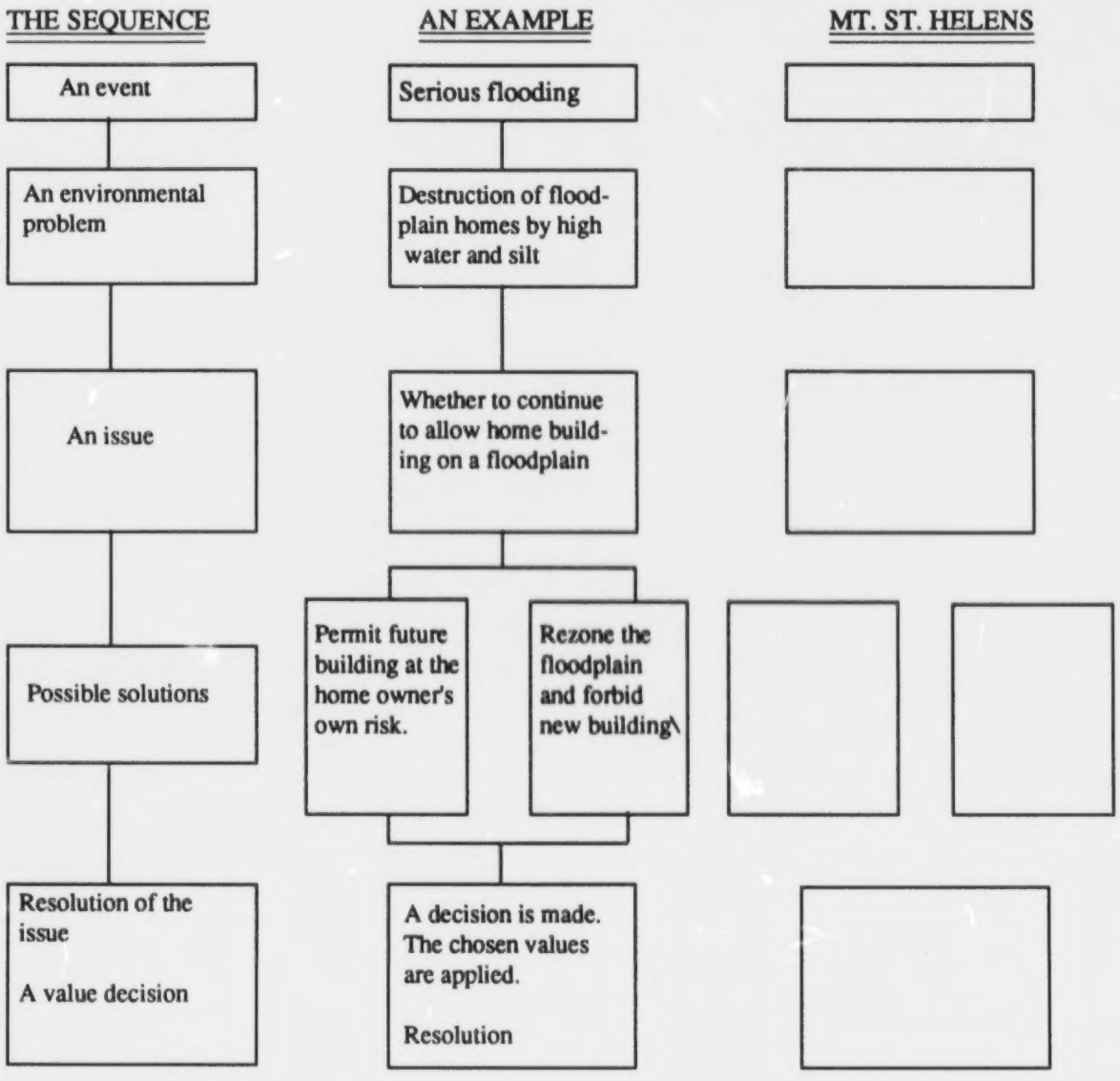
The diagram below shows how natural events might lead to environmental problems, which in turn can lead to environmental issues. Study the sequence leading from the event to an issue and finally to a resolution of the issue. Then try to complete a similar sequence using the eruption of Mount St. Helens as the natural event which starts the sequence. (I-6)

HOW TO LOOK AT ENVIRONMENTAL EVENTS, PROBLEMS & ISSUES

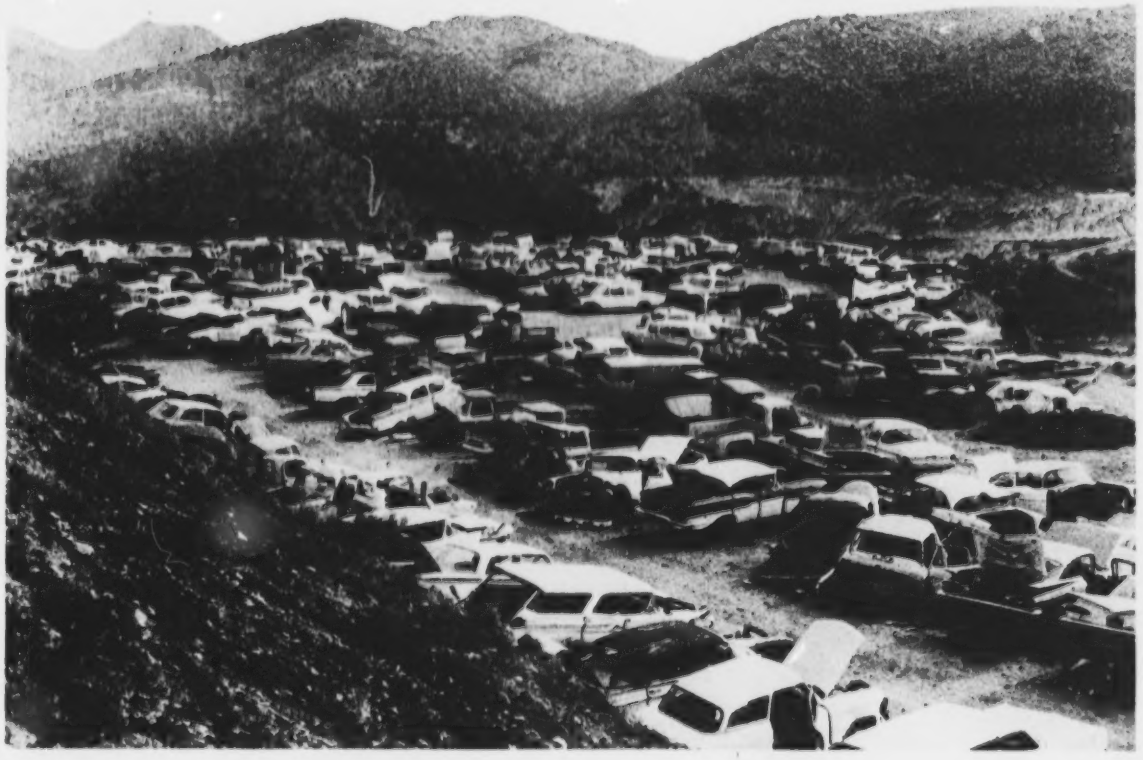

THE SEQUENCE
AN EXAMPLE
MT. ST. HELENS
An event
Serious flooding
An environmental problem
Destruction of flood-plain homes by high water and silt
An issue
Whether to continue to allow home build-ing on a floodplain
Possible solutions
Permit future building at the home owner's own risk.
Rezone the floodplain and forbid new building
Resolution of the issue
A value decision
A decision is made. The chosen values are applied.
Resolution

Environmental Problems and Issues
A Photo Essay

Automobile Graveyards

Few, if any, regions in the U.S. are without their auto graveyards. Not only are junked and abandoned cars an ugly sight, they also take up space on the planet that could be used more wisely. Perhaps of greater concern is the fact that these autos, vans, and trucks represent a tremendous resource in steel that could be recycled. The U.S. has well over 600,000,000 tons of discarded iron and steel rusting on the ground right now. Recycling could provide enough material to meet the U.S. demand for over a decade. For each ton of scrap steel and iron that is recycled, 1.5 tons of iron ore and 700 pounds of coal are **saved.**

How many junked cars and trucks show up in fields and vacant lots where you live? Are old autos recycled in your region? If not, why not? Investigate and find out.



Automobile Graveyard in Arizona. (Photo courtesy H. R. Hungerford)

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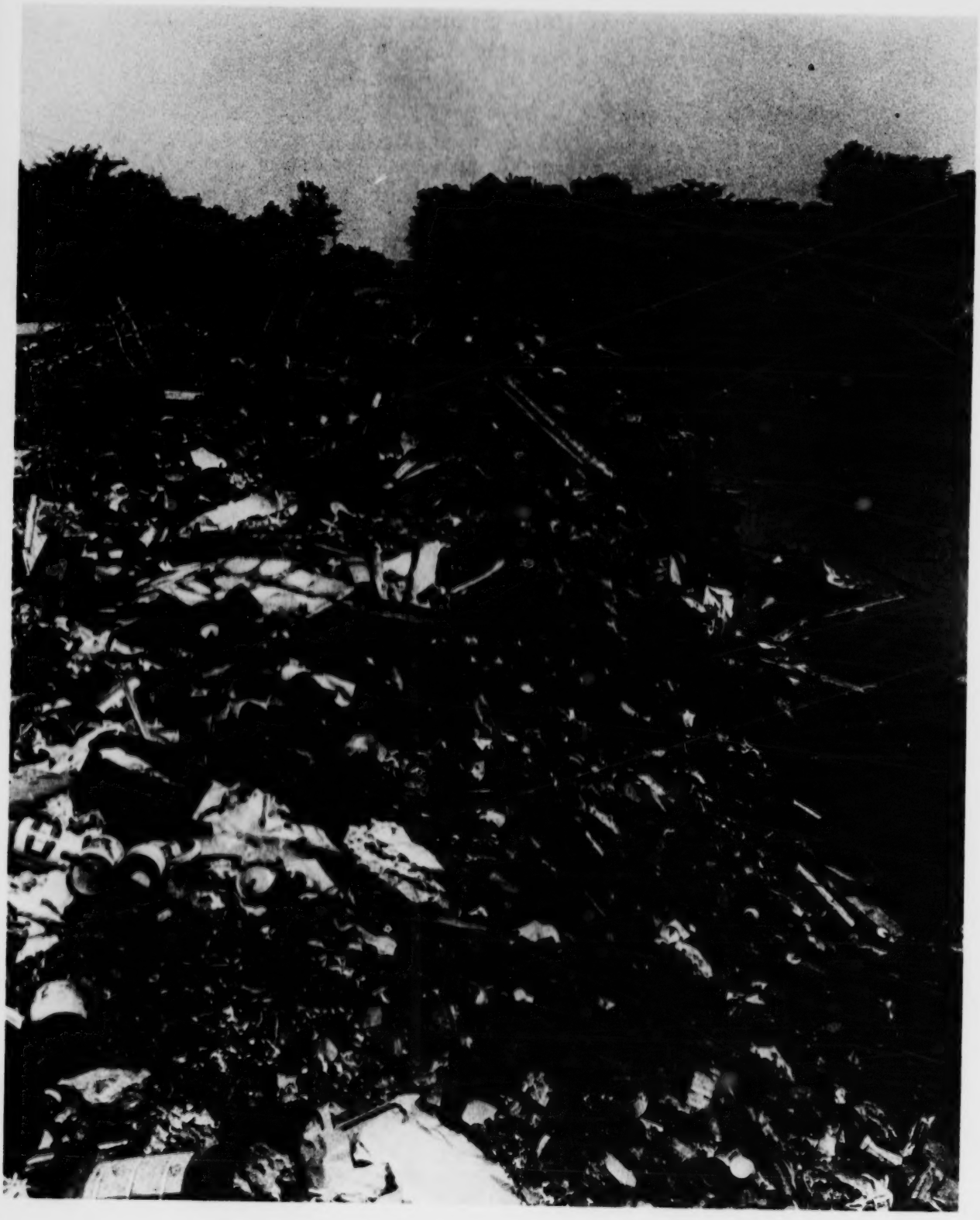

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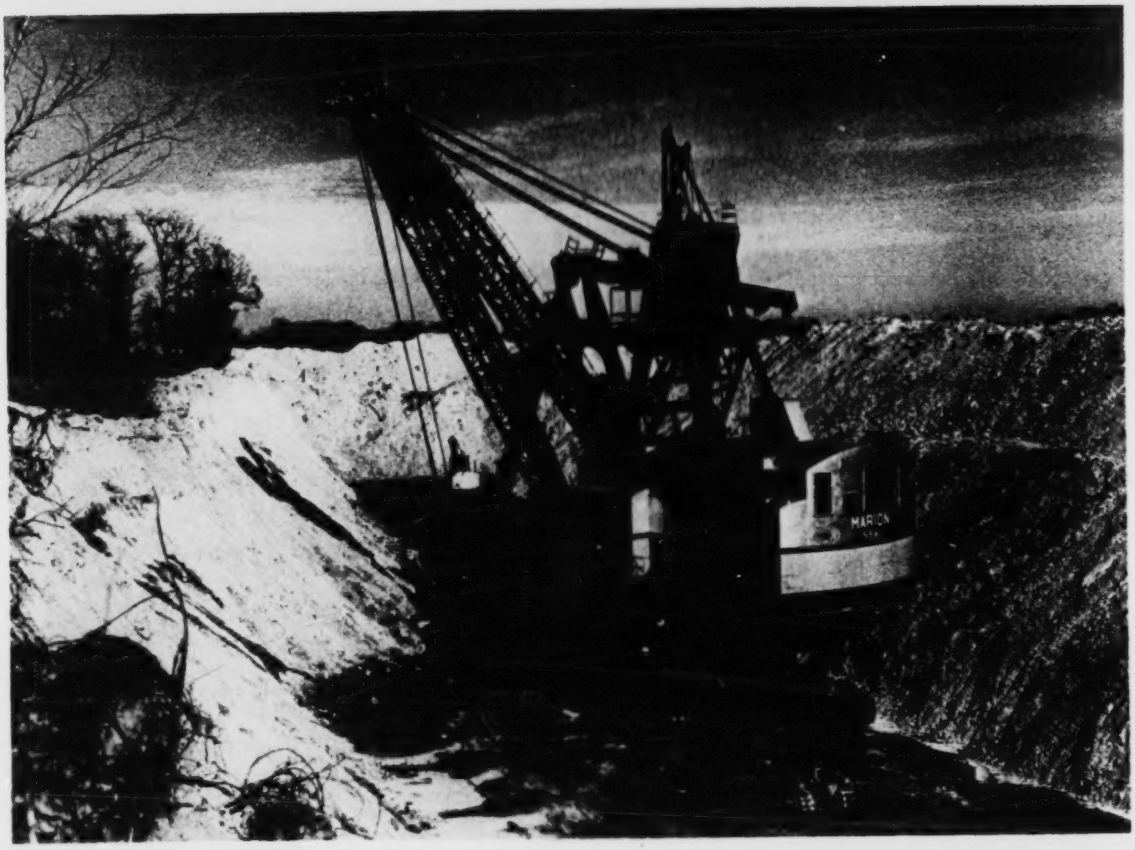
Illegal Dump in an Abandoned Strip Mine. (Photo courtesy H. R. Hungerford).

Many serious environmental issues are seen in this photo. New strip mine legislation guarantees that scenes like this will not be common. However, abandoned strip mines still scar the landscape in coal producing regions. It is also tragic that many people believe that these areas are public garbage dumps. This illegal dump is not only unsightly, it also helps make the water unsafe for any use. An immense amount of metal rests here that could be recycled and used again. A few years ago the trash heap of the U. S. for just one year - included the following:

Cans:	17,000,000,000
Jars and Bottles:	38,000,000,000
Tons of Plastic:	4,000,000
Television Sets:	7,600,000
Cars and Trucks:	7,000,000
Tons of Paper:	35,000,000

What is the waste situation in your community? Are there any environmental problems associated with waste disposal there? Are there any illegal dump sites? Is any of the waste recycled? If not, why not? Investigate this situation and find out.



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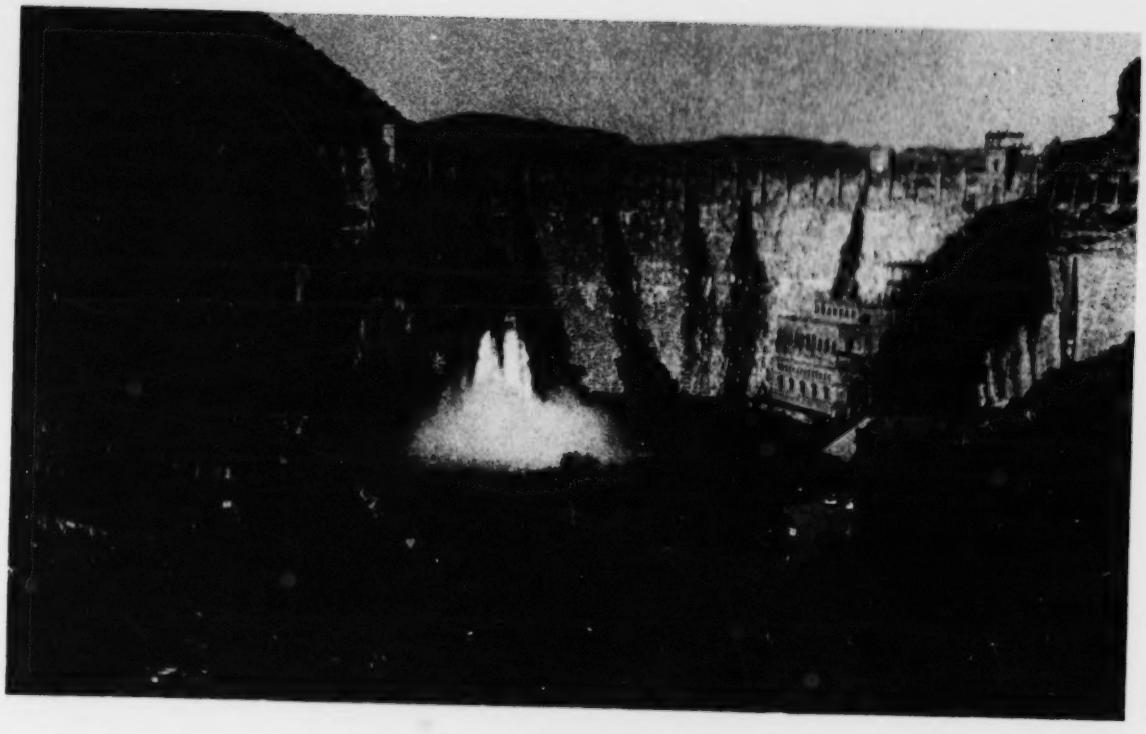
Flooded Homes on the Des Plaines River in Illinois. (Photo courtesy H. R. Hungerford)

Wise planning and land management could have prevented this costly tragedy. Floodplains should not be used for housing or industrial development. To prevent further damage to homes, the river might be dammed or channelized (deepened). However, these actions often create more complex environmental problems. They produce more floods downstream, increase sedimentation and erosion, and eliminate many kinds of wildlife. How should floodplains be used by man? How can concerned citizens convince people that misuse of floodplains creates environmental problems? Do land use problems similar to these exist in your area? Why not investigate and find out?

Midwestern Coal Strip Mine. (Photo courtesy H. R. Hungerford)

In the United States, hundreds of millions of tons of usable coal lie between 50 and 100 feet beneath the surface of the land. These coal reserves are available to surface or strip mining. In this scene you see the huge stripping shovel that removes the soil and rock from above the coal. In the background can be seen the small shovel used to remove the coal itself. In strip mining, the surface of the land is changed a great deal. Even with strict reclamation practices much of the land may never be as productive as it once was. However, with the demand for coal high, more and more land will be mined this way. An area twice the size of the state of Delaware has already been stripped. Even though more and more mining laws are passed, environmental problems remain. What might be some of the issues associated with strip mining? Why not investigate and find out?



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Roosevelt Dam in Arizona. (Photo courtesy H. R. Hungerford)

Few issues raise as many questions as does the damming of streams and rivers. There are many who are violently against damming natural waterways. There are also those who are very much in agreement with this practice. On one hand, dams can be used for water storage, flood control, and the generation of electricity. Also, certain kinds of recreation are promoted by the lake that forms behind the dam. On the other hand, hydroelectric power provides only a limited amount of electricity in the U.S. And, where the dam is built, the flow of the stream is sharply affected. Many plant and animal species are harmed. Also, in time, silt will fill the reservoir behind the dam, destroying the lake and its recreational value.

Aerial Photo of Chicago, Illinois. (Photograph courtesy H. Hungerford)

Well over 1000 square miles of land along the southern tip of Lake Michigan is covered by residential, business, and industrial developments similar to this portion of Chicago. The use of the land, air, and water by so many people creates many environmental problems. For example, what do you think causes the haze in the air on such a clear day as this? Would you consider this haze to be an environmental problem?

This city may seem to be largely independent. Yet, it must be provided with food, electrical energy, water, and a waste disposal system. What environmental problems can you think of that might be caused by taking care of these needs? What effects on the behavior of people do you think living and working in this metropolitan area might have? Could crime be a serious problem? Would you consider crime to be an environmental problem? Why? Why not?

Intersecting Highways Near Chicago. (Photo courtesy H. R. Hungerford)

Many environmental problems could be posed from this picture. Most of them concern land use. This scene represents a typical "urban sprawl". Notice the clustered neighborhoods and large open spaces between. What problems can you identify that could arise concerning the use of the automobile, space, and other resources? How do you suppose this land was used before the highways and housing developments came in? As more and more subdivisions are developed along these highways, what will be the effect on agriculture (the same agriculture that provides food for the city)?

Can you identify similar environmental problems in your own area? You don't have to live in or near a large city to see them. Does your area have an agency responsible for planning the use of land for both housing and commercial developments? What are its policies? Are they environmentally sound. Are the policies adhered to? If not, why not?

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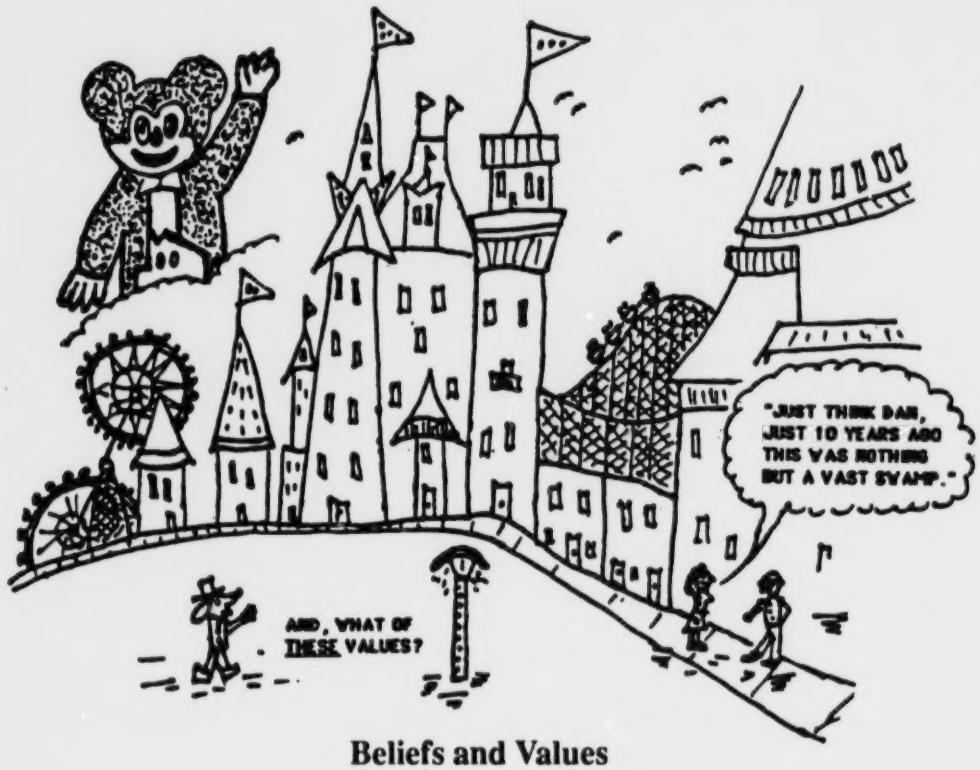

Beliefs and Values

When we speak of beliefs and values, we're getting to the heart of the matter. People may take different positions on the solutions to environmental issues. The position a person takes usually depends upon his or her beliefs and values. **A belief is an idea which a person holds to be true**. The idea may or may not be true, but the person believes it is.

In many cases, a person's beliefs are strongly tied to his or her values. **A value is the worth a person (or a group) places on something**. Usually, our values guide us in the choices we make.

Understanding beliefs and values is important in understanding just what an environmental issue is all about. You might say that there are two things which make an environmental issue what it is:

1. An issue includes man, the environment and interactions between the two.
2. An issue involves differing beliefs and values which lead to differing positions regarding the solution of the issue.

When people differ in their beliefs and values, they usually disagree on how an environmental issue should be solved. They have differing positions regarding the solution of the issue.

It is helpful for a person to be aware of his/her beliefs and values. This is so because conflicts sometimes arise within a person. Sometimes a person feels like he/she is caught between two values. The choice may not be between a "good" and a "bad", but rather between two "goods".

You can probably think of examples of value conflicts within your own classroom at school. For instance, cheating on tests is frowned upon. Many students think highly of themselves. They value their own honesty and wouldn't think of cheating. But, suppose you believed that the test was very important! Perhaps it was one which would decide your career, or would determine whether nor not you would go to college. And suppose your parents were really counting on you to do well on the test. Then your decision on how to act might be more difficult. You might value your own honesty. But that value might conflict with your value for "getting ahead", or for furthering your education, or for pleasing your parents.

Belief and value conflicts can also arise within a person when it comes to environmental issues. In order to understand and test our beliefs and values, it is helpful to look at them and discuss them with others. We're going to leave the Mount St. Helens issue for a while and give you a chance to examine some of your ideas about several environmental issues. You will have an opportunity to share your beliefs about these issues with your classmates. You will also be able to talk about why you feel the way you do and just what it is that you value. Some of your ideas may change slightly as a result of your discussion. Of course, you may also feel even more strongly about an idea after the discussion. We think you'll enjoy this activity. (I-7)

Environmental Beliefs and Values - Where Do You Stand? (I-7)

Directions: This activity is designed to let you compare a few of your environmental beliefs and values with those of your classmates. Below, you will find a list of six belief statements with which you may agree or disagree. Following each is a response line ranging from "Strongly Disagree" to "Strongly Agree". Please circle the "X" which best reflects how you feel about the statement.

1. The killing of deer by hunters plays an important part in keeping deer herds healthy.

X	X	X	X	X
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. Human females should not have more than two children.

X	X	X	X	X
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. The recycling of metals such as aluminum and steel should be mandatory even if it is not always profitable.

X	X	X	X	X
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. Air pollution standards should be relaxed in order to get better gas mileage in automobiles.

X	X	X	X	X
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

5. Only those people who live alone or have special problems should be allowed to keep a dog or cat because of the tremendous amount of food energy consumed by pets.

X	X	X	X	X
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

6. We should continue to build nuclear power plants in order to produce needed electrical energy.

X	X	X	X	X
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Next, we would like you to summarize your responses. After everyone in class has completed his/her responses, fill in the summary chart below. Add up the class responses in each category for each statement.

Summary Chart

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.				
2.				
3.				
4.				
5.				
6.				

Discussion Questions:

1. Analyze those statements for which there are wide differences of opinion. Why do these differences exist? Are the beliefs and values expressed environmentally sound? Why? Why not?

2. Sometimes a group will tend to load on the "neutral" category. When this occurs, what might be the reason? Could this circumstance be changed through more information? If so how?

3. Why is it difficult to resolve an environmental issue where there are strong and differing value positions?

The Basics of Issue Analysis

You've just spent some time examining your own beliefs and values. As you know, beliefs and values shape the positions held about an issue. Therefore, it is important that you be able to identify and interpret the beliefs and values at work in a real issue.

Those who participate in an issue are called "players". Their posture (what they think should be done) on the issue is called a "position". And those positions are related to the beliefs and values which they hold. To summarize, there are several key elements of an environmental issue. These include:

the **players** . . . . . the individuals involved in the issue;
the **players' positions** . . . . . what each player thinks should be done to resolve the issue; and
the **players' beliefs and values** . . . the important ideas held by the players and the worth they place on things.

Now, let's return to Mount St. Helens for another look at the issue of the fallen timber. What is the issue here? You might answer that the issue is " What should be done with the fallen timber in the Mount St. Helens National Forest?" What you have done is to identify and communicate the environmental issue. This is a skill you will use again later. On the following page you will find more information about that issue. See if you can identify the players and their beliefs and values.

The effort to protect Mount St. Helens in Washington's Cascade Mountains began many decades ago. The volcano's snow-covered cone, rising above a dark necklace of forest and reflected in Spirit Lake, was one of the most pictured scenic views in America. Over the years there had been various attempts to have a part of the mountain's slopes set aside as a national park or wilderness area. The lands were already owned by the federal government as national forest. But, there had been continuing pressure on the Forest Service to allow clear-cutting to encroach closer and closer to the most prized scenic areas. A group of concerned citizens, calling themselves the Mount St. Helens Protective Association, consistently fought for some kind of special congressional protection.

Then came the eruption in 1980. The Protective Association decided that the volcano's wilderness recreation values were as strong as ever. The picture-postcard perfection of Spirit Lake view was gone, but the mountain's wild beauty and remaining virgin forests were still awe-inspiring. And there was an added value, particularly for scientists: a unique opportunity to observe Mount St. Helens as a study site. The timber industry came on with a public relations campaign, which demanded immediate salvage of the timber blown down by the eruption's blast. They pointed to the economic importance of the timber to local communities. The association gave this answer: "A large part of the land we propose to protect is timberless mud-flows or ash deposits, and most of the timber in the rest of the area is either low quality, inaccessible, or both."

(Adapted from *Audubon Action*, February 1983)

Recognizing the players and their positions is usually not too hard. In the Mount St. Helens issue, the lumber company wanted to go into the national forest and salvage the fallen timber. The Protective Association wanted the area set aside as a national monument. Preserving this area would prevent any further lumbering. What were the beliefs and values behind each of these players and their positions? (I-8)

The Lumber Companies: _____

_____

_____

The Protective Association: _____

_____

_____

If you answered that the lumbering companies believed that the trees were economically important to local communities and were operating on ***economic values***, you are probably correct. The lumber companies are in the business of making money. The fallen trees looked like a ready and profitable resource to salvage.

You might also say that the Protective Association's position showed more than one value. The group believed that the area had awe-inspiring natural beauty. This suggests ***aesthetic values***. Aesthetic values refer to the sense of form and beauty. The group also believed that the area was useful for recreational and scientific activities. This suggests that they have ***recreational and scientific values***. In addition, the association stated that most of the timber in the area was of low quality or inaccessible. This suggests an ***economic value.*** If you were to organize these ideas (the issue, its players and their positions, beliefs and values, it would probably look like the Issue Analysis chart below. Study the chart carefully. It is important to observe a consistency between the position, the beliefs and the values.

The Issue: *What should be done with the fallen timber in the Mount St. Helens National Forest?*

The Player & Position	Belief Statement	Value
Lumber Companies: Allow timber companies to enter the area and remove the fallen timber.	The timber has economic importance to local communities.	Economic
Mount St. Helens Protective Association: Leave the fallen timber where it is.	The area's wilderness recreation potential is as strong as ever.	Recreational
	The mountain's wild beauty and the virgin forests are still awe-inspiring.	Aesthetic
	The general public and scientists can learn from observing the area.	Educational/ Scientific
	Most of the timber is of low quality or is inaccessible.	Economic

We are not here to suggest that one set of values is better than another. Rather, we think that identifying and understanding the beliefs and values in an issue is an important analysis tool. Below you will find a list of values which humans might hold. The list also contains definitions of those values. You will probably find this list helpful as you analyze issues. When you analyze issues, you may find yourself disagreeing with a classmate about the value which lies behind a belief statement. How will you decide who is correct? You can feel good about your value identification skills if you can explain how the value is based on the belief statement itself. Is the value which you have identified logically reflected in the belief statement?

ENVIRONMENTAL ISSUE VALUE DESCRIPTORS

The descriptors listed below may be helpful as you analyze issues. These statements attempt to name and define values which might be held by individuals. The definitions, as well as the list itself, should not be considered complete. They are simply tools to help you in a rather complex task!

Value:	Definition:
Aesthetic:	the appreciation of form, composition, and color through the human senses.
Economic:	the use and exchange of money, materials, and/or services.
Ecological:	pertaining to the maintenance of natural biological systems.
Educational:	concerning the accumulation, use, and communication of knowledge.
Egocentric:	pertaining to a focus on self-centered needs and fulfillment.
Environmental:	pertaining to human activities in terms of quality of natural resources, e.g., plant and animal species, air, water, soil, etc.
Ethical/Moral:	pertaining to present and future human responsibilities, rights and wrongs, and ethical standards.
Ethnocentric:	pertaining to a focus on the fulfillment of ethnic/cultural goals.
Health:	the maintenance of positive human physiological conditions.
Legal:	relating to national, state, or local laws; law enforcement; law suits.
Political:	the activities, functions, and policies of governments and their agents.
Recreational:	pertaining to human leisure activities.
Religious:	the use of belief systems based on faith or dogma.
Scientific:	concerning the process of empirical research; knowledge gained by systematic study.
Social:	pertaining to shared human empathy, feelings, and status.

The skill of issue analysis is so important that more practice is necessary to make sure you have mastered it. Read the article which follows below. The issue you will analyze is related to what should be done with some land which is to be strip-mined. Use the Issue Analysis Worksheet on page 31 to record your analysis (I-9). As you analyze the issue, check to make sure that you:

(1) identify and communicate the issue,

(2) identify and name the players and their positions,

(3) paraphrase each player's important beliefs, and

(4) decide what value(s) are implied by each belief statement.

Wetland Plan Has Farmers, Hunters At Odds

David DeWitte, *The Southern Illinoisian*, August 25, 1988

A mine permit hearing for the proposed Arch of Illinois Galum Creek Mine near Pyramid State Park drew a crowd of nearly 50 to the Perry County Courthouse. Although the mine will encompass some 4,600 acres, virtually all the controversy centers on Arch's plan to turn a 483 acre tract into wildlife habitat, which would later be donated to the state.

State and federal mining laws require that any land capable of crop production be returned to full agricultural productivity after strip mining.

Perry County Board Chairman Leonard Heisner said that too many acres of tillable farmland in the county has been lost as the county's economic dependency shifted to coal mining.

Farmers decried weed infestations and crop losses that have resulted from the rising winter visits of Canadian geese to the county. The geese usually visit the areas when grain in the wildlife preserves have been depleted in order to feed on the young, winter wheat plants.

Randy Zetter, a former Soil and Water Conservation District Chairman, said dollar costs from weed control "will be tremendous" for some farmers in the eastern portion of the county, where geese wintering at Rend Lake forage and introduce Johnson grass and cane grass seeds through their excrement.

Representatives of Ducks Unlimited, the Illinois Sportsmen Legislative Coalition, the Illinois Department of Conservation, and the Southern Illinois University - Carbondale Cooperative Wildlife Research Lab all voiced support for the project. They suggested the additional acreage at Pyramid State Park would help counterbalance the dramatic loss of wetland habitat throughout Illinois and the nation.

Legislative coalition president Fred Kirkpatrick suggested that farmers could gain by capitalizing on the needs of goose hunters. He said a single goose hunting pit could bring in $5,000 in a single season.

"Geese alone will save many a family farm in Southern Illinois this year," he said. Kirkpatrick added that delegations from other counties go to the state capital every year, "pleading for the opportunity that is being offered Perry County."

Illinois Department of Conservation spokesman James Moak praised the Arch proposal, saying that "Galum Creek will add a viable and highly utilized public recreation area."

He said the park is estimated to contribute $1.2 million to the local economy by bringing in about 150,000 visitors per year.

Even parents clashed on the wetlands impact on education. A Perry County mother decried the loss of property tax revenue from the land, about $1,600 to the schools. A father insisted his son could gain as much from a hunting trip as he could from a book.

Issue Analysis Worksheet

The Issue:

The Players & Positions	Belief Statements	Values

More About Issue Analysis

At this point you probably know that Issue Analysis is a very useful tool. It allows you to process a great deal of issue information. Often times, Issue Analysis will generate a number of questions about an issue. These questions are sometimes critical in order to completely analyze the issue at hand. The list that follows presents additional questions which could be useful for an "in depth" issue analysis.

Issue Information:

1. What additional information is needed to completely understand this issue (e.g., data, missing players, etc.)?

2. What additional information sources (e.g., experts, databases, periodicals, etc.) need to be found and used?

Information Evaluation:

3. To what extent were the players' beliefs based on evidence? Or, were they based on personal opinion without supporting evidence?

4. Are the players' beliefs biased? Bias refers to preconceived judgements, based on feelings, before the facts are known. Or, are their beliefs based on reason? Reason refers to interpretations that can be clearly and logically explained and justified.

5. Do there appear to be "hidden agendas" behind any of the belief statements? A "hidden agenda" may be reflected when a player voices one "belief" and hides the real belief behind his/her position. Often, the player will state a belief which is more socially acceptable than the actual belief which he/she holds. These are extremely difficult to deal with in Issue Analysis.

Issue Solution Evaluation:

6. Who is the decision-maker concerning the solution of the issue? Is the decision-maker an individual, a group, an agency, or some other unit?

7. What are the trade-offs related to the various solutions (i.e., positive and negative consequences)?

8. Do the solutions reflect "short-term outcomes" (i.e., a few years or decades) or "long-term outcomes" (i.e., many decades or centuries)?

9. To what extent do the solutions reflect sound scientific principles, i.e., do they use up-to-date scientific information related to the issue?

10. Are there possible unintended consequences related to the solutions? How likely is it that these will occur?

Environmental Issue Analysis - On Your Own!

By this time you should be getting very good at processing issue information. Now, it's time to apply the Issue Analysis skill to an environmental issue of your choosing. Your task is to identify an environmental issue, obtain your teacher's approval of that issue, and find information about the issue. Remember that the information you analyze should present the beliefs of the major players in the issue. Then complete the Issue Analysis process using the format you've become accustomed to. (I-10)

I would like to analyze the following environmental issue:_____

_____

_____

_____

Summarizing Environmental Issues

Now that you've come this far, you should have learned a great deal about environmental issues. We would like you to look back at the four environmental problems which you listed earlier in this module. How many of those are **issues**? Take your time in making your decisions. Your instructor may want you to discuss this with your classmates. Whenever you decide that one of the problems is also an issue, put a check in the column marked "Issue". (I-11)

We would like for you to do one more thing with the list of issues you came up with. Choose any two of the issues and tell why they are issues. Write your reasons below. Just write down your own ideas about why these might be considered issues. Do not worry right now about whether your ideas are 100% accurate. (I-12)

Why Are They Issues?

Chosen Issue:_____

_____

_____

Why this is an issue:_____

_____

_____

_____

Chosen Issue: _____

_____

_____

Why this is an issue: _____

_____

_____

Now, look back over your two issues and over the reasons you gave for them being issues. Check for two things. First, an environmental issue involves man, the environment, and interactions between the two. Do your issues include these three things? Second, your reasons should show that people have different beliefs and/or values about the solutions for the issue. Check your reasons to see if they show conflicts in beliefs and/or values.

Alright, where are we now? We've been studying environmental issues. We have also talked about beliefs and values. This all started when you were asked if you knew what environmental problems were. You've gone past the idea of environmental problems. You have also tackled the idea of environmental issues. How well do you think you can define or describe what an environmental issue is. Please, write out your definition below. Be sure to keep in mind the things you've worked on so far. Again, your instructor might ask you and your classmates to come up with a definition of "environmental issue" which can be posted in your classroom. (I-13)

My definition of "environmental issue":

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

MODULE II

GETTING STARTED ON ISSUE INVESTIGATION

Introduction

Module I gave you a general overview of environmental problem solving. In the next three modules you will prepare yourself to investigate environmental issues of your choice.

Some of you will want to study an environmental issue which exists in your school, in the community, or in the area where you live. In this case, you can often go right to the problem and observe it with your own eyes. But, some of you will want to investigate issues that cannot be observed firsthand. For example, this would be the case if you were interested in world population issues, conserving tropical rain forests, environmental health hazards in developing nations, or problems facing endangered species that exist outside of your home region.

This module will help give you the skills you need for collecting information using secondary sources. It will not provide all of the answers though. But, it will help a great deal.

Whenever you do careful research you must be as thorough as you can. Also, you must think critically at each step. Only by being thorough and thinking things through carefully will your conclusions be good ones.

The objectives for Module II follow.

Objectives for Module II

Upon completion of Module II you will be able to . . .

1. ...using the information concerning the skill of classification, accurately group fifteen different environmental issues into each of three assigned categories.

2. ...logically defend the classification scheme produced as a result of Objective 1.

3. ...using information about ways of investigating environmental issues, reclassify the original issues in terms of how they can be attacked for study.

4. ...after reading a description of an environmental issue, correctly identify the research questions that apply to that situation from a list presented to you.

5. ...after reading a description of an environmental issue, identify and communicate research questions that are consistent with that issue.

6. ...given a set of research questions about an environmental issue, evaluate each against the rules for writing research questions.

7. ... compare two information sources about coal reserves, identify the important data (information, positions and values,) in each source and communicate how these data differ.

8. ...identify governmental or private agencies to which you can write for specific information about an environmental issue.

9 ...write a sample letter to an agency asking for information about a particular environmental issue. The letter is to be correct in terms of general structure, the agency chosen to be contacted, and the kinds of information requested.

10. ...read two environmental news articles and state at least two differing value positions as expressed in each article.

11. ...locate and read one environmentally-related article approved by your instructor and write a brief summary which accurately communicates the main point(s) presented.

12. ...choose an environmental issue, locate three good references concerning this problem, and correctly list these in written form.

13. ...correctly identify the written information (and symbols) used on a card from the card catalog.

14. ...correctly identify the written information (and symbols) used in a reference from the Reader's Guide.

15. ...analyze a research report dealing with polar bear management and ...

    A. cite one source of information to which the author might have written for more information.
    B. explain why the author was unable to answer one of the questions asked in the report.
    C. determine if the values of the author toward polar bear management are in the report. Cite evidence to support your determination.
    D. state specifically why you consider (or do not consider) the research project to be a good, thorough job of covering the subject.

Looking for Environmental Issues

The purpose of the activities listed below is to help you and your classmates develop a pool of environmental issues. Environmental issues are everywhere. You probably just haven't paid attention to how frequently they occur. Recently there have been many reports of the destruction of the tropical rain forest, the depletion of the atmosphere's ozone layer, the contamination of groundwater by agricultural chemicals and leaking landfills, health risks associated with radon gas seeping into residences, air pollution standards in metropolitan areas, the use of wildlife skins in the fashion industry, the use of Alaskan wilderness areas for oil exploration and recovery, and many, many others.

Reports of these issues can be found in popular magazines, newspapers, radio news, television news, and television specials. In order to become more aware and knowledgeable of these environmental issues, your teacher might ask you to help your class make a collection of reports and information about environmental issues. The following activities are examples of what could be done to make an **issue collection**.

1. Make an **issue notebook** by clipping issue articles from newspapers and magazines.

2. Keep a **diary** of environmental issues reported on the evening television or radio news.

3. Obtain and bring to class past issues of magazines that might have information about environmental issues (*National Wildlife, Outdoor Highlights, Outdoor Life, Time, Newsweek, Audubon, etc.*).

4. Invite an **environmental resource person** to speak to the class. The president of a local/regional environmental organization, a state conservation officer, a representative from the state Environmental Protection Agency office, local hunters and trappers, and birdwatchers are all good examples of potential speakers.

5. Tape record, audio and/or video, reports of special programs from radio and television about environmental issues.

6. Obtain and view films, tapes, and filmstrips about environmental issues obtained from the school media center, the local public library, and the high school library.

THANK HEAVEN! SIGNS OF CIVILIZATION!

Needless to say, this is not an overnight task. You might well search for some time before a good collection of issues is assembled. Remember, you are looking for **environmental** issues. Environmental issues contain players who disagree. Further, they should involve man-environment interactions. Social, political, and other types of issues which contain only man-man interactions are not appropriate.

Once your issue collections are underway, you will be asked to use your background knowledge to classify those issues. Scientists use many skills (observing, comparing, measuring, experimenting, etc.) to study the objects and events of the environment. One of those useful skills is **classification**. When a scientist classifies, he/she groups objects or events into sets that contain closely related kinds.

One way that we can look more clearly at environmental issues is to classify them. We could classify environmental issues in many different ways. We could group them according to whether they were issues connected with air, water, soil, sound, animal life and so on. We are going to ask you to classify issues in yet another way. Please identify one environmental issue that could fit each of the following headings. (II-1)

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A **local environmental issue**, one within your school or community:

_____

_____

A **regional environmental issue**, one within the region or state:

_____

_____

A **national environmental issue**, one within the nation:

_____

_____

An **international environmental issue**, one within (or between) several nations:

_____

_____

Actually, what you have done (if your issues are correctly identified) is to begin a classification scheme. It is based on the geographic scope of the issue. This way of grouping looks at how large a geographic area is affected by the issue.

Your next task is to use your class issue collection to expand the issue lists for each geographic heading. If your issue collection is inadequate, you might search the library for more issue information. Use your own knowledge or go to newspapers, science journals, and reliable magazines. As you identify environmental issues, record them in the space provided. Identify at least three per heading. (II-2)

Local Environmental Issues:

1. _____

2. _____

3. _____

4. _____

5. _____

Regional Environmental Issues:

1. _____

2. _____

3. _____

4. _____

5. _____

National or International Environmental Issues:

1. _____

2. _____

3. _____

4. _____

5. _____

Your listing of environmental issues should contain specific issues - ones that you can describe or communicate accurately. Listing the "health risks associated with ozone" is much more specific than listing "air pollution". Check your list to make sure your have specific environmental issues. Revise your list if necessary.

Your teacher will probably want to make a class list of the issues on the blackboard. There might be issues supplied by classmates that you did not include on your list. Use these new environmental issues to complete your list. Don't fail to ask questions about those issues you don't understand. When you have finished you should have a pool of fifteen or more environmental issues in which you might be interested

At this time, we are going to ask you do one more task in connection with the fifteen issues you classified (Activity II-2). Let us assume that your instructor was going to ask you to become an expert on one or more of these issues. How would you go about becoming an "issue expert"? There are probably at least three ways of becoming an expert.

FIRSTHAND (PRIMARY) DATA. You can go out and get information on a first-hand basis. This means that if you want to become an expert on the rat population in Chicago, Illinois you will have to go to Chicago and collect your data. This could involve figuring out a way to estimate the number of rats, trapping and checking rats for fleas and other parasites, going through the medical records for cases of rat-transmitted diseases or rat bites, as well as many, many other things. Because these data are obtained from the direct observation of *primary sources*, they are often called **primary data**.

SECONDARY DATA. Another way to get information about an environmental issue is to use what are called *secondary sources*. You might read research reports, books, newspapers, and magazines, inspect maps, look at documentary photographs and bring all this information together in a final report of your own. Let's pretend you wanted to investigate the killing and conservation of the great whales throughout the world. It would be pretty difficult to visit the South Pole and other whaling areas as part of your classroom activity. But, information on the great whales is available. All you have to do is dig it out and put the facts together. You need not observe the primary sources directly. Rather, you may use another author's observations and communication of information.

COMBINATION (primary/secondary): The third way to become an expert is to use a combination of the two techniques discussed above. With some issues this is entirely possible. For example, if you want to investigate the land reclamation practices of strip miners (and you live in a region with strip mining), you would want to check the laws and regulations, write and interview experts, as well as investigate practices firsthand in your own region.

Your task is to now go back through your classified issue list (II-2) and CODE each issue. You will need to determine whether the issue can be investigated using firsthand (primary) sources, secondary sources, or a combination of sources. Use the code system below and write your answer in the margin to the left of each issue. (II-3)

Code: **F** = Firsthand Investigation
S = Secondary Source Information
C = Combination of F and C

When you are finished, your instructor might want wish to check your coding. Perhaps he/she will want the class to discuss the logic used in the particular codes on this assignment.

Actually, what you have done is to **CLASSIFY** your issues in still another way. Can you explain why this is a different but still logical classification?

WHY ME ? WHY NOT BEWARE OF . . . ACID RAIN . . . POLLUTED AIR . . . TOXIC WASTES CONTAMINATED GROUND WATER . . . LOSS OF AGLAND . . . OVER POPULATION . . . OZONE DEPLETION . . . NOISE POLLUTON . . . POOR LAND USE MANAGEMENT . . . WHY ME ?
BEWARE OF THE BEARS

BEST COPY AVAILABLE

Identifying Research Questions?

You now have a classified pool of environmental issues available for use. But, how can we use these issues to get started on an investigation? Remember, starting issue investigation is the focus of this module. The activity that follows was designed to teach you a method of analyzing environmental issue information in order to identify and write research questions.

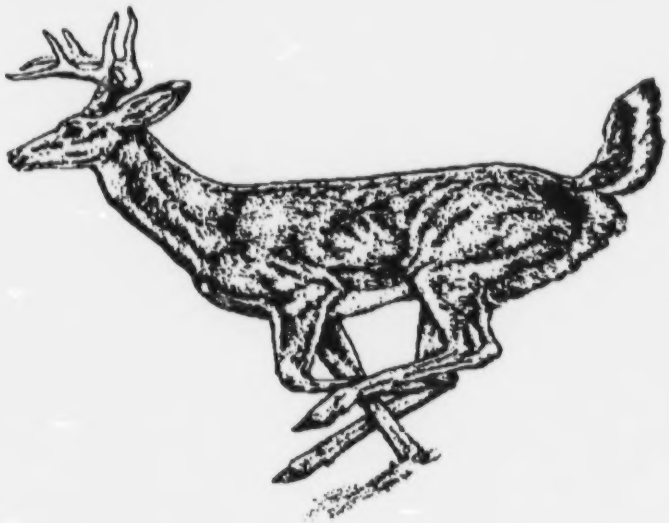
Before dealing with research questions, a real-life, historic situation will be presented. This situation contains issues dealing with the Pennsylvania deer population and the conflict between wildlife biologists and the public. Let us list a few scientific facts about deer for you to consider before you read further. These data concerning deer are:

1. Deer, when uncrowded in a region, can often grow large and strong.

2. Deer, when crowded, can overgraze available land and starve in the process.

3. When conditions (food, space, etc.) are good, female deer (does) will breed in large numbers in the fall.

4. When conditions are poor, does will breed in smaller numbers.



5. Where natural predators (mountain lions, etc.) do not exist, deer populations can grow to enormous numbers in only a few years.

6. About 25% of a deer herd can be killed each fall without decreasing next year's population. In other words, if there are 4000 deer available and 1000 are killed in the fall, there still will be 4000 deer available next year due to reproduction.

7. Many deer killed by hunters in the fall would normally die that same winter from natural causes.

8. Killing one in four deer in the fall will often result in a healthier deer herd the following spring.

9. Overgrazing by deer destroys the habitat for other species, e.g., rabbits, grouse, wild turkeys, etc.

10. Huge populations of starving deer can do tremendous damage to agricultural crops in some areas.

Wildlife biologists have this data. They know that there is only so much range available to deer. They know how many deer can be harvested - better, they know how many deer **should** be harvested in order to keep the deer herd healthy. But, many people don't have these facts or refuse to listen to the facts. You will read about the situation in Pennsylvania.

The Pennsylvania Deer Story

We must turn back the years and return to Pennsylvania around 1910. At this time, Pennsylvania was introducing deer into regions from which they had almost been exterminated. We won't go into the reasons why deer had become extinct here, but forest fires plus the development of the state by man had a great deal to do with it.

In any event, after 1910, forest fire control was established. Because of this, the food supply for the deer in the state was excellent. Deer feed on what wildlife experts call "browse". Browse largely consists of the tender new growth produced by trees each spring and summer. Young forests produce about 880 pounds of available deer food per acre per year. The amount of food (browse) decreases at a fantastic rate as the forest grows. A hardwood forest that is 35 years old will produce only about 110 pounds of browse per acre. This is much less than the 880 pounds produced by the very young forest.

You might wonder why an older forest produces less available browse than a younger forest. There are several reasons for this. First of all, in a young forest there are many young seedlings producing food. Also, the browse is close to the ground where the deer can reach it.

As the forest grows, many seedlings die due to competition for space. Remaining trees grow tall and the food produced is grown at a height where the deer cannot reach it.

Getting back to the Pennsylvania story . . . . around 1930 it was estimated that the state's forests could have a **healthy** deer herd of about 250,000 animals. Instead, a rich food supply had allowed the animals to reproduce to over 750,000 individuals. You must also remember that deer had few natural enemies in Pennsylvania forests at this time. Even a ten year old who knows something about ecology could tell you that trouble was just around the corner.

The wildlife biologists of Pennsylvania knew that the situation was serious. Winter food supplies for the deer were just not extensive enough to support this many animals. As deer became hungry they began invading agricultural land. Thousands of deer were shot by farmers trying to protect their crops. The Pennsylvania Game Commission spent nearly $100,000 to build over 200 miles of deer-proof fence over a 14 year period. This didn't do much to solve the problem. Further, the deer were overgrazing their natural woodland area which also seriously hurt other wildlife species such as rabbits and wild turkeys. Many deer died of malnutrition. Poachers took a few illegal deer but this didn't make much of a dent in the population either. Other weak and hungry deer were being run down and killed by wild dogs.

A hardwood forest with good deer browse (Photo by H. R. Hungerford)

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During this time there was a law on the books that allowed the legal hunting of **only** male deer (bucks) with antlers. Wildlife biologists, trying to maintain healthy herds, recommended a change. The state legislature passed a law which also permitted the killing of female (antlerless) deer. The next year public pressure was so intense that the law was changed back to permit the hunting of only male deer. Over a 25 year period, the law was modified 14 times to permit the taking of antlerless deer. Each time it was passed, it was recalled due to public pressure. Despite the changes in the law, many people turned out to legally shoot deer for meat and, over the 25 year period, nearly 1,000,000 animals were killed.

At the end of this heavy kill period, Pennsylvania had a formula for hunting which worked like this: For two years, hunting would be permitted only for mature bucks. During the third year, antlerless deer could also be killed. During these third years upwards of 100,000 deer were often killed legally. But, the public screamed about the killing of so many deer. There was widespread bad publicity about the killing of antlerless deer. A buck-only law was put back into law due to public sentiment.

In an effort to increase food production for the deer, the Pennsylvania Game Commission permitted heavy timbering of some forested areas. This could help promote the growth of young trees. In some areas they even took bulldozers and leveled larger areas to promote the growth of seedlings. But, all of this did little good because the deer population was so huge that the animals cleaned out the new growth before it could get a good start.

The Game Commission had the facts and tried to present them to the public. They knew that a **healthy** deer herd depended on keeping the number of deer under control. The best way to control the population was to allow licensed hunters to remove excess animals of **both sexes**.

This was the way things stood at the middle of this century. The Game Commission knew what had to be done. The public fought it every step of the way. This is, obviously, a story containing a number of historic environmental issues. Two of the more critical issues appear to be the following:

Issue 1: Should both male and female deer be harvested in an area where there are no natural predators and a limited food supply?

Issue 2: Should public sentiment be allowed to affect the use of ecologically sound game management principles in the setting of state wildlife policies?

Let's pretend that these are still live issues. (And, indeed, they are in some areas.) Let's also pretend that we want to **investigate** these issues. We might begin an investigation by thinking about the issues. **The key is to identify the variables contained in each issue.** Variables are specific factors or conditions, e.g., number of deer, beliefs about deer hunting, crop damage due to deer, etc.

The first issue involves the variable, **gender of harvested deer.** The second issue involves two variables, **public sentiment** and **ecologically sound policy making.** Using these variables, an investigation could be begun by asking any or all of the following questions:

1. To what extent do certain groups of Pennsylvania citizens (hunters, non-hunters, anti-hunters, and wildlife biologists) have differing beliefs about the harvesting of female deer? (Related to Issue 1.)

2. To what extent are Pennsylvania citizens knowledgeable about ecology and game management concepts? (Related to Issues 1 and 2.)

3. To what extent does the ecological knowledge of Pennsylvania citizens affect their beliefs about whether female deer should be harvested? (Related to Issue 1)
4. What are the beliefs and allied values of Pennsylvania state legislators concerning deer hunting legislation? (Related to Issue 2.)

5. To what extent do Pennsylvania wildlife biologists support a public education program designed to promote ecologically-sound beliefs about deer management ? (Related to Issue 2.)

6. In what ways does public sentiment concerning deer hunting influence game management policy in states other than Pennsylvania? (Related to Issue 2.)

These six questions are examples of **research questions** related to environmental issues. They can be used to start and guide issue investigations. They were derived by a process of . . . . (1) stating the issue, (2) identifying the variables within the issue, and (3) using the variables to write research questions.

There are other issues and variables in the Pennsylvania deer story. Some variables include **the reintroduction of an endangered species, the use of timbering to improve food for wildlife, crop damage due to overpopulated deer, deer poaching,** and **the use of deer fences.** Please write a research question using one or more of these variables. Do not worry about the form of the research question at this time. (II-4)

Your Research Question:

_____

_____

_____

_____

All science starts with a question . . . . usually a lot of questions. Answers to these questions are attempted by collecting related data and interpreting it. The point is this . . . it all begins with questions. Questions supply the focus, and guide all the specific science processes that follow. So, now you know the role of research questions. They begin investigations by providing a research focus and, to a large extent, control what happens in the investigation. The authors' goal is to train you to investigate environmental issues. It is important that you learn to write research questions. **Specifically, it is critical that you learn how to analyze issue information in order to write research questions.**

Research Question Rules

There are several important rules for writing research questions for environmental issue investigations. These research questions ...

1. ...are always **stated in question form**.

2. ...always **avoid simple "yes" or "no" responses.** This is usually achieved by beginning with phrases such as "To what extent" and "In what ways".

3. ...always **indicate a population or area.** The population refers to a group on which the research question is focused, e.g., Pennsylvania hunters, wildlife biologists, etc. The area refers to the geographic area in which the data will be collected, e.g., Midwestern states, Randolph County, Dewey Elementary School, etc.

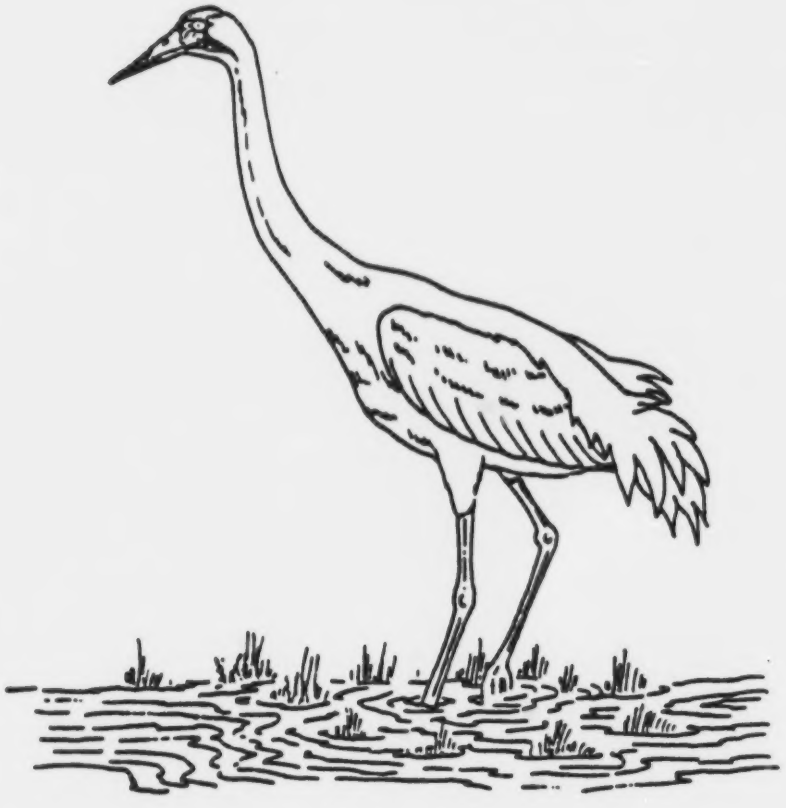
4. ...are always **derived from and related to environmental issues.**

5. ...when possible, **specify the variables to be measured.** A variable is a given factor or condition, e.g., knowledge of ecology, attitudes toward poaching, size of the deer population , etc. The following research question specifies the variable to be measured: What are Illinois deer hunters' **attitudes** toward the harvesting of female deer?

6. ...when possible, **specify a relationship between two variables.** The following question seeks to find the extent that one variable (knowledge of ecology) affects another variable (attitudes about deer harvesting): To what extent does ecological knowledge affect Illinois deer hunters' attitudes toward the harvesting of female deer?

7. ...are **important in an environmental and social sense.** Issues dealing with endangered species, toxic waste disposal, feral animal populations, deforestation of rain forests, contamination of ground water supplies, wilderness preservation, and the integrity of national park ecosystems are examples of issues which have implications for humans as well as for the environment.

The authors realize that writing good research questions takes a lot of practice. Another environmental issue situation will be presented for you. This one involves whooping cranes. Your task will be to analyze the information in such a way that you can write good research questions.



Whooping Cranes

A young whooping crane recently died from lead poisoning. Only two wild flocks of these birds are still in existence. This young crane was one of twenty-nine whoopers which winter at the Bosque Del Apache National Wildlife Refuge in New Mexico.

Snow geese also winter on the Bosque refuge, and hunting of the geese is permitted. Hunters are trained to avoid shooting the cranes, but the goose hunt still drives the whoopers from the refuge. To avoid hunters, the cranes often feed in the surrounding countryside. This is where the problem occurs. Waterfowl hunting is widespread in the countryside. So is the accumulated lead shot from the guns of hunters. As the whooping cranes forage on the ground for food, they take in lead shot, just as they swallow fine pieces of gravel to serve as food grinders in their digestive systems.

An autopsy revealed that the gizzard of the young crane was full of lead. Three lead pellets were also found in the whooper's flesh, indicating that it had been shot as well as poisoned. Even more troubling is evidence that refuge hunting might be interfering with the reproduction of the cranes. Usually, a male and female whooper will form a pair bond and mate for life. This pair bonding occurs on the wintering ground. It appears that goose hunting might be disrupting the pair bonding. If so, then hunting could be an indirect cause for the problems that this flock is having in reproducing.

The National Audubon Society has demanded an end to the hunting on the Bosque refuge. Since snow geese can be hunted elsewhere in the region, there seems to be little reason to continue hunting on the refuge. This organization has also called for the use of non-toxic steel shot in the near-by areas.
(Adapted from "Unhealthy Refuge," *Audubon*, March, 1984)

Your job is to analyze this information, identify the variables, and write good research questions. Begin by making a list of the variables involved in this issue. (II-5)

Now, using one or more of these variables, write two good research questions that, when used to focus an investigation, would help supply the data to understand the issues more clearly.

1.

2.

Let's try one other research question activity. We want you to evaluate several research questions using the criteria provided earlier in this module. These research questions might contain major flaws. Or, they might match the criteria. Your job is to decide which of the following are good research questions. Then, tell why you think the question is or is not a good one! (II-6)

1. Is refuge hunting a problem? Evaluation:

2. Is refuge hunting affecting whooping cranes? Evaluation:

3. To what extent does snow goose refuge hunting affect whooping crane pair bonding on the Bosque Del Apache Refuge? Evaluation:

Looking for Environmental Issue Information

Let's review a bit. The purpose of this module is to get you started in issue investigation. You now have a pool of environmental issues. You know how to analyze issue information to identify issues and variables , and how to write research questions. Pretend that you have written research questions and now you need information to help you answer the research questions. Finding good information is the key to good research. The following pages will describe several methods of obtaining information. They include (1) using the library to find secondary sources, (2) writing letters to environmental organizations, (3) writing letters to governmental organizations, and (4) interviewing local resource people.

Below you will see lists of secondary sources of information. In no way are they complete listings. Your chances of finding good information using other sources are excellent. Most libraries, for example, will have a card catalog. Use it! Larger libraries also have a publication called The Readers' Guide. Here you can find listed all major articles written on just about any topic on which you want to do research. The lists that follow are intended only to get you started.

Examples of Periodicals and Newsletters with Research Value:

Title	Publishing Organization
Audubon	National Audubon Society
C. F. Newsletter	Conservation Foundation
Environmental Action	Environmental Action, Inc.
International Wildlife	National Wildlife Federation
National Parks	National Park Association
National Wildlife	National Wildlife Federation
National Geographic	National Geographic Society
Natural History	American Museum of Natural History
Nature Conservancy News	The Nature Conservancy
Population Bulletin	Population Reference Bureau
Wilderness Report	The Wilderness Society

Organizations Involved in Aspects of the Environment

Acid Rain Foundation
1410 Varsity Dr.
Raleigh, NC 27606

American Museum of Natural History
Central Park West at 79th St.
New York, NY 10024

American Petroleum Institute
1220 L St., NW
Washington, DC 20005

Animal Welfare Institute
P.O. Box 3650
Washington, DC 20007

Bureau of Land Management
U.S. Dept. of Interior
18th and C Sts., NW, Rm 5600
Washington, DC 20240

Bureau of Mines
2401 E Street, NW
Washington, DC 20241

Center for Environmental Education
625 9th St., NW
Washington, DC 20001

Clean Water Action Project
1320 18th St., NW
Washington, DC 20036

Coastal Society
P. O. Box 2081
Gloucester, MA 01930-2081

Conservation Foundation
1255 23rd St., NW
Washington, DC 20037

Cousteau Society
425 East 52nd Street
New York, NY 10022

Defenders of Wildlife
1244 19th St., NW
Washington, DC 20036

Department of Energy
Forrestal Building
1000 Independence Ave., SW
Washington, DC 20505

Eagle Foundation
300 East Hickory
Apple River, IL 61001

Electrical Power Research Institute
3423 Hillside Ave.
P.O. Box 10412
Palo Alto, CA 94303

Environmental Action Foundation, Inc.
1525 New Hampshire Ave.
Washington, DC 20036

Environmental Defense Fund
257 Park Ave. South
New York, NY 10010

Environmental Policy Institute
218 D St., SE
Washington, DC 20003

Forest Service
P.O. Box 2417
U.S. Dept. of Agriculture
Washington, DC 20013

Friend of Animals
11 West 60th St.
New York, NY 10023

Friends of the Earth
218 D Street, SE
Washington, DC 20003

Fund for Animals
200 West 57th St.
New York, NY 10019

Greenpeace USA, Inc.
1436 U Street, NW
Washington, DC 20009

Humane Society of America
2100 L. St., NW
Washington, DC 20037

Izaak Walton League
1401 Wilson Blvd.
Level B
Arlington, VA 22209

League of Women Voters
1730 M St., NW
Washington, DC 20036

National Audubon Society
950 Third Ave.
New York, NY 10022

National Coal Association
1130 17th St., NW
Washington, DC 20036

National Geographic Society
17th and M Streets, NW
Washington, DC 20036

National Oceanic and
Atmospheric Administration
Rockville, MD 20852

National Park Service
Interior Bldg.
P.O. Box 37127
Washington DC 20013

National Parks and
Conservation Association
1015 31st St., NW
Washington, DC 20007

National Rifle Association
1600 Rhode Island Ave., NW
Washington, DC 20036

National Trappers Association
P. O. Box 3667
Bloomington, IL 61702

National Wildlife Federation
1400 16th St., NW
Washington, DC 20036

Nature Conservancy
1815 North Lynn Street
Arlington, VA 22209

Nuclear Regulatory Commission
1717 H Street, NW
Washington, DC 20555

Office of Surface Mining
1951 Constitution Ave., NW
Washington, DC 20240

Planned Parenthood Federation
810 Seventh St.
New York, NY 10019

Population Reference Bureau
777 14th St., NW - Suite 800
Washington, DC 20005

Resources for the Future
1616 P St., NW
Washington, DC 20036

Sierra Club
730 Polk Street
San Francisco, CA 94109

Smithsonian Institution
1000 Jefferson Drive, SW
Washington, DC 20560

Soil and Water Conservation Society
7515 NE Ankeny Road
Ankeny, IA 50021

Toxic Substance Project
Environmental Action Project
1346 Connecticut Ave., NW
Washington, DC 20036

Union of Concerned Scientists
26 Church Street
Cambridge, MA 02238

Wilderness Society
900 17th St., NW
Washington, DC 20006

Wildlife Information Center
629 Green St.
Allentown, PA 18102

World Wildlife Fund - U.S.
1250 24th St., NW
Washington, DC 20037

Worldwatch Institute
1776 Massachusetts Ave., NW
Washington, DC 20036

Zero Population Growth
1400 16th St., NW - Suite 320
Washington, DC 20036

Regional Offices of the U.S. Environmental Protection Agency:

Region I EPA
Room 2303
J. F. Kennedy Federal Building
Boston, MA 02203

Region II EPA
Room 1009
26 Federal Plaza
New York, NY 10278

Region III EPA
841 Chestnut St.
Philadelphia, PA 19107

Region IV EPA
345 Courtland St., NE
Atlanta, GA 30365

Region V EPA
230 South Dearborn
Chicago, IL 60604

Region VI EPA
1445 Ross Ave.
12th Floor, Suite 1200
Dallas, TX 75202

Region VII EPA
726 Minnesota Ave.
Kansas City, KS 66101

Region VIII EPA
999 18th St., Suite 500
Denver, CO 80202

Region IX EPA
1235 Mission Street
San Francisco, CA 94103

Region X EPA
1200 6th Street
Seattle, WA 98101

Getting All Sides of an Issue: Comparing Information Sources

You can get into a great deal of trouble when using secondary sources. Why? Because, if you are not careful and thorough, you'll wind up with only one side of the story. This is very dangerous when it comes to making decisions.

You will recall learning that environmental issues reflect differing human values. In fact, if there weren't different sets of values, there would not be any issues. If some people did not value quiet, there wouldn't be anyone complaining about noise pollution around major airports. If certain people didn't throw gum wrappers, match covers, and beer cans along the roads and in the streets (or parks), we would have little concern about littering. If all utility companies used effective emission control devices on their smoke stacks, few people would complain about air pollution caused by electric utilities. If all towns and cities had good sewage treatment plants, there would be little need for health officials (and others) to be concerned about the pollution of streams and rivers.

All the issues above have two sides - sometimes several sides - to them. Rarely is it possible to get two sides to an issue in one publication in the popular press, such as the following two articles which appeared in *Insight*. In this one issue of *Insight*, we find an editorial by Woody West concerning the African elephant that disagrees sharply with the substance of a news article on the same topic written by Stephen Brooks. Please read these articles carefully. Then, you will be asked to compare these two information sources!

Elephants die in order to provide the tusks from which human beings make expensive decorative objects. (Photo courtesy of H. R. Hungerford)

"Means of Defense Is Proving to be Elephant's Ruin"

Stephen Brooks, *Insight*, November 13, 1989

SUMMARY: ... In 20 years the species [elephant] may be no more, warn conservationists who backed an October vote by a convention to ban international trade in ivory. In just 10 years, herds have been cut in half, mostly due to poaching, which is believed responsible for as much as 80 percent of the ivory trade. Enforcement of the ban will be difficult; thus, ending demand is seen as the most important step toward halting the killing.

When delegates to the Convention on International Trade in Endangered Species gathered in Lausanne, Switzerland, Oct. 9 to debate the future of the African elephant, it was clear they were readying for an ugly fight. In one camp, an alliance of Western conservationists and a majority of African countries was insisting that the elephant be granted endangered species status, a move that would stop legal trade in ivory and pull the plug on the illegal poaching that has halved Africa's herds in the past decade. In the other camp, a cozy cartel involving South Africa, Zimbabwe, Botswana and Japan was equally determined to see the profitable trade continue. Before the planes [carrying delegates to the Convention] even hit the ground, the two sides had locked tusks.

Banning trade was a wrongheaded policy, the southern Africans argued, because it robbed elephants of the very value that ensured their survival. Making them economically worthless merely meant that native populations, who compete with the elephants for land and who sometimes see them as pests, would not hesitate to kill them off. The 'elephanatics' in East Africa should do what Zimbabwe and South Africa do, they advised: cull a percentage of their herds every year and sell the ivory, meat and hides on world markets. Since those profits could be plowed back into protection, conservation and rural development, the ivory trade actually protected the elephants and helped the economies of the countries that owned them. Besides, they said, outlawing legal trade would only push up the price of ivory on the black market, making the poaching problem worse.

But what worried conservationists was that continuing the limited trade would open a pipeline for poaching ivory, letting smuggling networks that control the trade and make the most of the money from it continue to thrive. Both Zimbabwe and South Africa have had abysmal records in policing well-known smuggling routes through both countries. And given the immense money to be made in smuggling, said many conservationists, it was unrealistic to think anything short of a total ban would work.

After a week of ... debate, the signatories voted 76-11 (with four abstentions) to put the elephant on the list of endangered species and end, starting in January, all international trade in ivory. Zimbabwe, Mozambique and Botswana took reservations from the decision, saying they would continue to trade. But in a turnaround that caught many by surprise, Japan said it would respect the ban; and with the American and European markets effectively closed, the southern African countries will have a tough time finding buyers for their ivory.

The decision came at a time of precipitous decline in the number of African elephants. Due almost entirely to a rash of poaching to stock a thriving illegal ivory market, the population has been reduced from 1.3 million 10 years ago to 630,000 today. As the price of ivory rose from $2.50 a pound in 1960 to $14 a pound in 1973 and as much as $170 a pound early this year, the elephant

became a quick and easy source of income. The civil wars and instability in many African countries only threw fuel on the fire: As automatic weapons became commonplace from Somalia to Chad to Namibia, the rate of the slaughter reached 2,000 a week. Put an end to the ivory trade, conservationists warned, or the African elephant could become extinct in as little as 20 years. 'What we've seen in the past decade is one of the greatest mammalian holocausts in this century,' says Ian Douglas-Hamilton, a consultant to the World Wildlife Fund, who has studied the elephant in Africa for several decades.

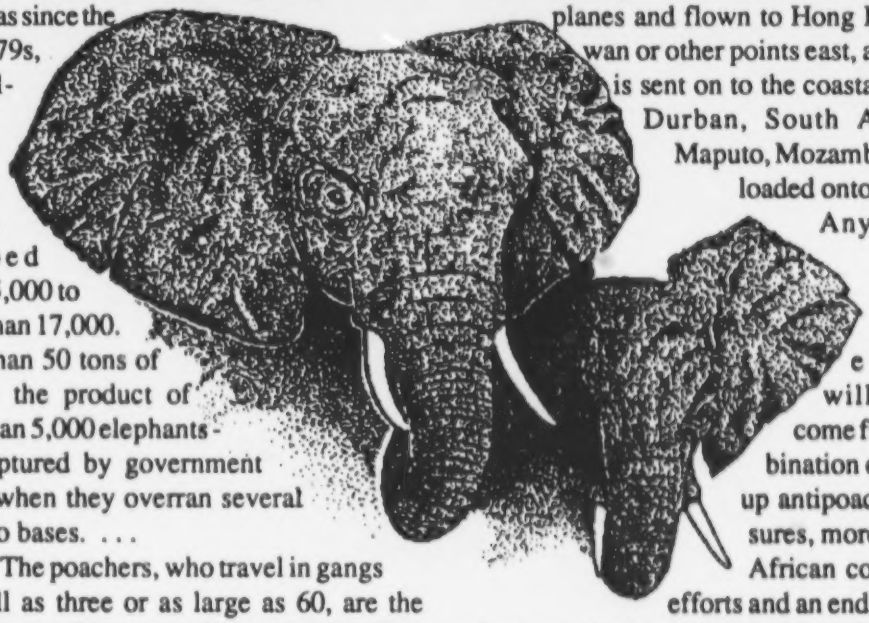
Under pressure from people like Douglas-Hamilton, the world began to take notice. In 1986 the trade group voted to move the elephant onto the list of threatened species - one grade below endangered - and drew up a system to ensure that only legally obtained, government-approved ivory would be traded in world markets. It was a good idea, but it quickly turned into a fiasco: Well-financed ivory traders soon figured out how to get around the restrictions, and the convention-sanctioned legal trade soon became little more than a front for a flourishing international business in cut-price, poached ivory.

The 300 tons of ivory that left Africa legally last year amounted to only a tiny fraction of what ended up on world markets. By most accounts, some 80 percent of the ivory trade has been in poached tusks (Tanzania says it is closer to 94 percent), fueling a trade worth as much as $500 million a year. Little of that money ever returned to Africa; the profits stayed with powerful and secretive trading syndicates based in Hong Kong and Singapore that controlled elaborate operations stretching from Africa's wildlife reserves and hidden factories in Dubai to the traditional carving centers in Hong Kong and Japan.

This ivory carving, available in many stores in the U. S. at the time of this writing, provides an example of what the elephant/ivory issue is all about. The desire of some consumers for this kind of artistry drives the demand for ivory and, therefore, the poaching of elephants. (Photo courtesy H. Hungerford)

... While the high price of ivory fueled poaching, the proliferation of high-powered weaponry across Africa made it possible on a grand scale. While poachers in earlier decades had to rely on single-shot guns or even spears to hunt elephants, the poachers now have AK-47s, G-3s, even RPG-7 rocket launchers. ...

The path of destruction has been wide. Chad's herds have been slashed since civil war broke out in 1979; Uganda has only 1,500 to 2,000 elephants left from the 20,000 that roamed in the Sixties - most cut down by trigger-happy soldiers during Idi Amin's rein. In Angola, . . . rebels have killed tens of thousands of elephants - as many as 100,000 by some estimates. ... in Mozambique, where the government has been fighting Renamo guerrillas since the mid-1979s, the elephant numbers have dropped from 55,000 to fewer than 17,000. More than 50 tons of ivory - the product of more than 5,000 elephants - was captured by government troops when they overran several Renamo bases. ...



The poachers, who travel in gangs as small as three or as large as 60, are the bottom rung of the smuggling networks. They have to spend weeks in the bush and rarely make more than $5 a pound for the ivory. With shoot-to-kill policies in effect in Kenya, Tanzania and some other countries, they risk their lives every time they pick up a gun. 'The guy who gets the worst deal - after the elephant - is the poacher,' says Leakey [Richard Leakey, head of Kenya's Wildlife Service]. 'He's the least paid, takes the greatest risks and has the hardest life.'

A typical operation will spend days stalking a herd, then move in for the kill. Once the elephants are downed, the tusks are removed as quickly as possible, often by hacking off the animal's entire face. The raw tusks are then moved on foot to the outskirts of the park and buried.

Dug up later by the smugglers, they will be sent by truck or camel on one of several main smuggling routes; tusks from southern African countries often move down a well-established route that runs through Lusaka in Zambia, crossing into Botswana at the Kazungula border post, then into South Africa at Martinsdrift. From there the ivory goes to Johannesburg, where some is loaded onto planes and flown to Hong Kong, Taiwan or other points east, and the rest is sent on to the coastal towns of Durban, South Africa, or Maputo, Mozambique, to be loaded onto ships. ...

Any full reprieve for the African elephant will have to come from a combination of stepped-up antipoaching measures, more money to African conservation efforts and an end to demand for ivory in the major markets of the United States, Europe and Japan. Of all of these, ending demand is the most important. 'It's people who will save the African elephant,' says Kenyan wildlife official Leakey. 'Not little bits of paper signed in Switzerland.'

A Better Way to Save the Elephant
The Last Word

Woody West, *Insight*, November 13, 1989

A herd of international white hats has acted decisively . . . to save the vanishing African elephant by banning all trade in ivory. However, this nobly imagined step - with George Bush heading the U. S. cheerleaders - may not preserve the threatened species at all. There are those who are convinced that the ban in fact will hasten the destruction of the beasts.

The African elephant isn't having a jolly time of it, no question. Its population decline has been brutal. Ten years ago, there were in the neighborhood of 1.3 million of the huge mammals on the continent, and now there are 630,000; in Kenya, which has banned most uses of ivory for a decade, the number of elephants in that period plummeted from 65,000 to 19,000. The prodigious decrease is attributed to the high demand for raw and processed ivory and the fierce audacity of poachers.

Therefore, the white hats reasoned, outlaw the ivory trade and everything will be dandy . . . With President Bush's blessings, Congress this summer prohibited importation of ivory and ivory products. As did the European Community. Then, with the World Wildlife Fund galloping to the fore, the ivory banners went global. A few weeks ago, the U.N.-sponsored Convention on International Trade in Endangered Species overwhelmingly voted for an absolute ban among its 91 member nations.

The world, or at least Africa, was supposedly made safe for elephants. Hooray! Right? But there may be a small problem here. More than 60 nations are not parties to the outlawing of trade in ivory, and there may be one or two bad guys out there shrewd enough to realize even bigger bucks can be made *because of the ban* - and they will keep the poachers fully occupied in killing. Forcing a commodity into the black market invariably pushes up its value.

Might there not be a mechanism more effective than prohibition? Yes, as it happens, there is. . . . Randy Simmons and Urs Kreuter examined this approach in an article in the quarterly The Public Interest, noting that Zimbabwe has been particularly successful with the alternate method.

'Zimbabwe's policies are based on the belief that the best way to protect the elephant is to insure that people benefit from their use and thus have a vested interest in their preservation,' they write. How? Permit the killing of a limited number of elephants each year to maintain the herds at a size compatible with the environment so they do less damage in heavily agricultural areas; revenue from the culling goes to the locals as well as a portion of the money from selling permits to wealthy hunters. The poachers lose their incentive, the local residents gain a significant one.

During the decade in which Kenya's elephants were disappearing, Zimbabwe's increased from 30,000 to 43,000. Zimbabwean farmers in one district along the Zambezi River earned $125,000 last year as their share of 'conservation by utilization,' The New York Times reported. Botswana, Malawi, Namibia and South Africa are among the African nations also using this policy, and their elephant herds are increasing at 5 percent annually. . .

Good luck, elephants. Maybe George Bush will attend the funeral when the last big beast is slain.

Comparing Information Sources About the African Elephant

The "ivory issue" is a very hot issue today for environmentalists and the commercial ivory market. This may be because the ivory trade has been and may currently be a significant threat to the survival of the African elephant. Stephen Brooks and Woody West have described different solutions to a very real dilemma. Below, we would like you to summarize and compare the main points made by each writer. (II-7)

1. Briefly summarize the main point presented in the Stephen Brooks article:

_____

_____

_____

_____

_____

2. Briefly summarize the main point presented in the Woody West editorial:

_____

_____

_____

_____

_____

Both writers appear to place value on the preservation of the African elephant. However, the article and the editorial differ to some extent on the values reflected by the information presented. Stephen Brooks reports the argument that the demand for ivory must be ended in order to halt the killing of elephants in Africa. Woody West, on the other hand, argues that the demand for ivory should be acknowledged and the elephant species saved another way. Both writers reflect an "environmental value" in their texts. However, very important and different values underlie each article. What are they?

What is the underlying value in the Brooks article?

_____

_____

_____

_____

What is the underlying value in the West editorial?

Many people think that the "ivory" issue has been settled since a number of important nations have finally banned trade in ivory. However, Woody West thinks otherwise. What do you think? Is it possible that a black market will now come about as a result of this ban? Or, will all nations and people who profit from ivory respect the ban? And, what do you think about the actions recommended by the World Wildlife Fund?

Letters for More Information

The sale of ivory products is not the only issue related to the elephant. The elephant is a source of trouble for African farmers who have settled land in areas originally populated only by the elephant and other wild animals. Other products are made from elephants, e.g., cowboy boots made of elephant skin and umbrella holders made from the feet of the animals. Some indigenous people in parts of Africa still hunt the elephant as a source of meat. In some areas there is a serious debate over whether the large tracts of land needed for the elephant should be preserved versus using that same tract of land for settlement by increasing populations of indigenous peoples. Other issues are also present. These issues are available for you to research if you wish.

In researching an issue, there are many times when it is necessary to sit down and write for more information. Although letter-writing is something you probably learned in your English class, there are a couple of points you should always to keep in mind when writing an information-seeking letter.

First, go to the source that seems to be the best for your particular purpose. Some students make poor choices as to where to write for information. However, at this time we would guess that you could make good choices. Let's see how well you can do this.

Earlier, you found a list of organizations that might be able to provide information about aspects related to environmental issues. For example, included in that list were The American Museum of Natural History and World Wildlife Fund. Both of these agencies might be able to provide additional information related to some aspect of the African elephant and issues surrounding it.

On the following page, you will find two specific questions. Please indicate the agencies or organizations you could write to for information relating to each question. (II-8)

Question 1: How many acres of North American wetlands are drained or otherwise lost each year? (To which agencies could you write?)

Choice 1:_____

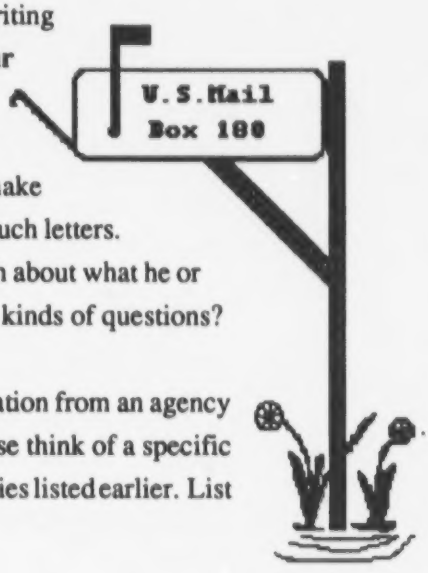
Choice 2:_____

Question 2: What human values are at work which contribute to the growth in the human population? (To which agencies could you write?)

Choice 1:_____

Choice 2:_____

There is a second point you need to keep in mind when writing for information. It is simply this: **Be very specific in your request!** People who work in the agencies to which you write have a big complaint. They get letters from students requesting all the information they have - on everything. Such requests make their job impossible. Some agencies have stopped answering such letters. Requests like this indicate that the student has not thought much about what he or she is doing. Can you blame officials for not answering these kinds of questions?



How well do you think you could do requesting information from an agency by letter? We are going to give you a chance to find out. Please think of a specific piece of information that you might obtain from one of the agencies listed earlier. List that information below.

Requested Information: _____

_____

_____

Now, on a separate sheet of paper write that letter. Your letter will be judged in terms of its general structure, whether you have writtento an appropriate agency, and whether you have been specific in your request (II-9).

Seeking Information From Resource People

Often your local community contains individuals who know a great deal about certain environmental issues. These people are usually willing to share their information. Resource people may also have pamphlets, maps, and other literature on a specific topic. In your search of secondary sources, do not overlook the possibility of contacting such people.

If you choose to seek information through a personal contact, remember to apply the same points that were emphasized about writing letters for information. Choose the best resource person for your particular purpose and be specific in your request for information.

When you meet with the resource person, be courteous and polite. These people are often quite busy, so you don't want to take too much time for an interview. Plan your questions carefully beforehand so that you can be efficient during the time you have. A final suggestion is to remember that each person you contact for information has his or her own value position. As you go over the information you have received from a resource person, remember that it may show you only one position on the issue. Evaluate the information carefully!

Examples of resource people who may provide valuable information related to environmental issues follows:

Examples of Local Resource People:

U. S. Senator or Representative
State Legislators
County Board of Supervisors
County Clerk
County Conservation Officer
City Mayor and City Council
City Manager
City Zoning Commission
Corporate or Industrial Personnel
Science Teachers
Agr. Chemical Dealer/Distributor
County Health Department
Microbiologist
Registered Nurse
Zoo Curator
Insect & Rodent Control Specialist
Animal Control Specialist
Museum Curator/Director
Water Plant Superintendent
Waste Water Engineer
Mortician
Social Studies Teacher
Real Estate Developer
Newspaper Editors and Reporters
Environmental Organization Members
Anthropologist
County Extension Officer
Physician
Wildlife or Waterfowl Biologist
Fisheries Biologist

Summarizing What You Read

If you study a problem that forces you to go to a secondary source, you are going to have to keep some sort of record to keep the facts straight. And, you are going to have to show where you got your information.

One way to keep records is to use note cards or a section of a notebook in which you record summaries of the articles you read. Any summary should hit hard at the main point(s) of the article in a logical and understandable manner.. It should be complete enough to be useful when you need it. However, it should also be to the point, without unnecessary word-age.

It would take too much space to reprint a full-length article here and then summarize it for you. Even so, we are going to cite an article and write a summary of it so you can see a real summarization of an article dealing with an environmental issue.

Let us assume we are investigating air pollution from automobile emissions. What follows is a summary of one of the articles read:

Lyden, J. "Nobody Wins With Lead," *National Wildlife*, December 1984-January 1985, p. 46-48.

> In January 1984, aldermen in the Chicago City Council began a heated debate over whether to ban the sale of leaded gasoline within the city limits. Some felt the ban was needed in order to bring relief to the biggest victims of lead poisoning: underprivileged children.
>
> Lead, found in the exhaust from gasoline engines, displaces other minerals in the human body. It often settles in bone and brain tissue. The result: learning problems, retardation, and a number of health disorders. Because they live closer to heavy concentrations of traffic and its fumes, poor children are seven times as likely to have high blood levels as middle-class children.
>
> In Chicago, economics seemed to be at the heart of the debate. The Illinois Gasoline Dealers Association warned the City Council that the ban would cost the city millions of dollars in lost tax revenues and fees. Jobs would also be lost as dealers and buyers

moved outside the city limits to avoid a ban. Alderman Joseph Kotlartz argued back, "The medical testimony shows that leaded gas is depriving our children of full life, and in some instances of life itself." In September 1984, the debate ended. Chicago became the first city in the U.S. to outlaw the sale of leaded gasoline.

At this point in time we are going to ask you to read an article concerning one environmental issue and summarize it. Following this paragraph is a list of suggested articles which could be chosen for such a task. Your instructor may also give you permission to read a different article.

Article Reference List

Armstrong, S. "Cutting the Rhino's Losses," *International Wildlife*, January-February, 1990, 22-24.

Begley, S. "The Lessons of Chernobyl," *Newsweek*, April 27, 1987, 4.

Brookes, S. "Means of Defense is Proving to be Elephant's Ruin," *Insight*, November 13, 1989, 34-38.

Chadwick, D. H. "Elephants - Out of Time, Out of Space," *National Geographic*, May 1991, 2-49.

Cole, J. N. "We're Losing Our Precious Farmland!" *National Wildlife*, August-September, 1982, 12-15.

Edmondson, J. "Hazards of the Game," *Audubon*, November, 1987, 23-37.

Ellis, R. and McCosker, J. E. "What Fate Awaits the Great White Shark?" *Audubon*, September-October, 1991, 100-108.

Fine, S. "Eating Our Way to a Warmer World," *World Watch*, May-June, 1989, 41-43.

Gibney, F. "Louisiana Bayou Blues," *Newsweek*, June 22, 1987, 54-55.

Iker, S. "Swamped With Deer," *National Wildlife*, October-November, 1983, 4-11.

LaVo, C. "Not In My Backyard!" *National Wildlife*, April-May, 1988, 24-25.

Lawren, B. "Getting Into a Heap of Trouble," *National Wildlife*, August-September, 1988, 18-24.

Laycock, G. " 'Good Times' Are Killing the Keys," *Audubon*, September-October, 1991, 39-49.

Laycock, G. "Socking It to the Poachers," *Outdoor Life*, January, 1981, 54-55+.

Lemonick, M. D. "Shrinking Shores," *Time*, August 10, 1987, 38-47.

Lewis, T. "High Stakes in the Land of Plenty," *National Wildlife*, June-July, 1987, 4-11.

Lipske, M. "How Safe Is the Air Inside Your Home?" *National Wildlife*, April-May, 1987, 34-41.

Luoma, J. R. "Black Duck Decline: An Acid Rain Link," *Audubon*, May, 1987, 18-27.

MacDougall, W. "Crisis Ahead in Our National Parks," *U.S. News and World Report*, September 27, 1982, 74-75.

Martin, R. , "Harbor Cleanup Is No Tea Party," *Insight*, June 13, 1988, 24-25.

McNamee, T. "Breath-Holding in Grizzly Country," *Audubon*, November, 1982, 68-83.

Merrit, J. "Requiem For A Heavyweight," *Modern Maturity*, April-May, 1991, 55-61.

Miller, J. N. "The Energy Crisis: There Is an Easy Answer." *Reader's Digest*, June, 1980, 73-81.

Murphy, J. "The Quiet Apocalypse," *Time*, October 13, 1986, 80.

Peterson, C. "Scenic Sites Under Siege," *National Wildlife*, June-July, 1987, 44-45.

Peterson, I. "Watch on Acid Rain," *Science News*, July, 1987, 36.

Robbins, J. "Grizzly and Man: When Species Collide," *National Wildlife*, February-March, 1988, 21-27.

Ryan, J. "Plywood vs. People in Sarawak," *World Watch*, January-February, 1991, 8-9.

Schaller, G. B. "Saving China's Wildlife," *International Wildlife*, January-February, 1990, 30-40.

Shea, C., P. "Building a Market for Recyclables, " *World Watch*, May-June 1988, 12-18.

Steinhart, P. "Empty the Skies," *Audubon*, November, 1987, 70-97.

Taylor, R. A. "Another Day Older and Deeper in Trash," *U.S. News and World Report*, May 11, 1987, 20-21.

Tennesen, M. "Kelp: Keeping a Forest Afloat," *National Wildlife*, June-July, 1992, 4-11.

Wexler, M. "Sacred Rights," *National Wildlife*, June-July, 1992, 18-23.

Wilson, E. O. "Rain Forest Canopy: The High Frontier," *National Geographic*, December, 1991, 78-107.

Young, J. "Tossing the Throwaway Habit," *World Watch*, May-June, 1991, 26-33.

Write your article summary in the space provided. (II-10)

The Article: _____

_____

_____

The Summary: _____

_____

_____

_

The Search for References

You have just finished summarizing one article. Perhaps you found the subject matter interesting - perhaps not. Of course, you might also have found the article to be of little value in terms of that particular environmental issue. As you know, not all references are of equal worth. Not all references agree. Some reflect misinformation or only one value position. Once again, we point out that **it is important to obtain more than one viewpoint when using secondary sources.**

Can you find more than one reference on a particular topic? How good are your research skills? We are going to ask you to pick a topic that demands the use of secondary sources. When you have picked your topic, you are to search for three (3) separate articles or similar references on that topic. Unless your instructor tells you otherwise, you are to complete this search in the library.

Once the topic has been chosen, find information from at least two (2) different sources. This simply means that we do not want you to pick a topic and then get all of your information from one source, e.g., *National Wildlife*.

When you have found all three references please list them in the space provided further in this module. The listing of articles in the previous section should help you see how these articles should be listed.

A listing of issue topics follows from which you may choose. Or select a topic of your own choice, if your instructor gives you an okay. Some topics are more difficult to research than others.

Possible Issue Topics for Library Research: (II-11)

solid waste disposal
toxic waste disposal
protecting great whales
soil erosion
preservation of salt water estuaries
ecological effects of pesticides
seashore erosion
destruction of the rain forests
depletion of the ozone layer
desertification of Africa
endangered species of Hawaii
glass and metal recycling
conservation of bald eagles
human population explosion
salmon farming
endangered plant species
depletion of fossil fuels
protecting national parks
pollution of the Great Lakes
oil spills
groundwater contamination
coyote population expansion

State the Issue Topic Chosen: _____

References (from two different sources):

1. _____

_____

2. _____

_____

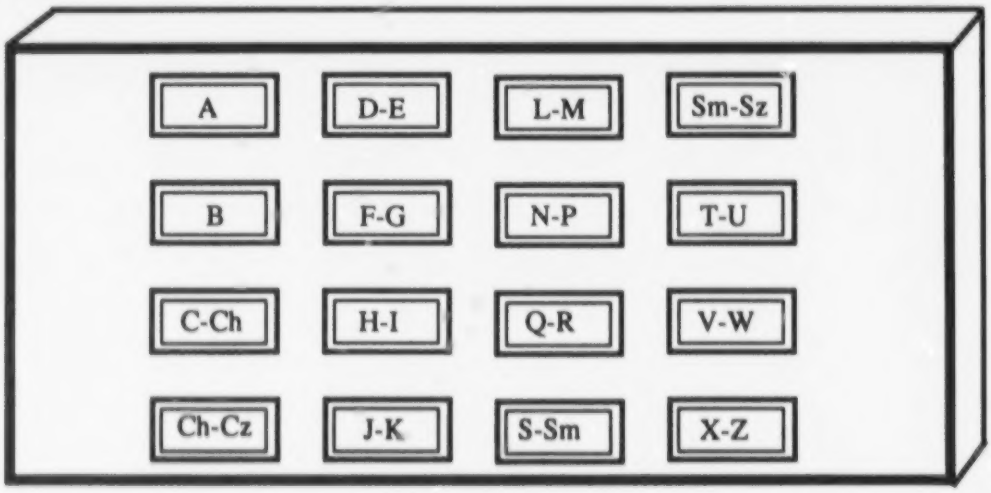
3. _____

_____

You might have noticed some frustration in finding good articles from references in the library. Maybe your library skills need sharpening. The library is an excellent place to gather information, but you must know how to use it. If you are not an expert, the next few pages will help.

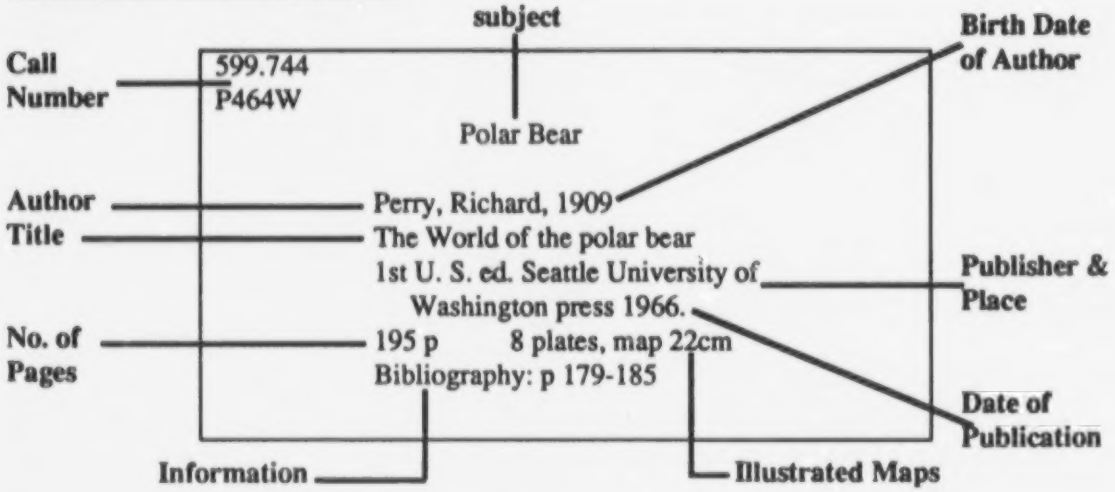
Library Skill 1: Using the Card Catalog

Most libraries contain one or more card catalogs. Using a card catalog is a good way to find appropriate books in your library. These catalogs are usually located in wooden or metal filing cabinets containing one or more cards on every book found in that library. The drawers, as well as the cards found within them, are arranged in alphabetical order. On each drawer is one or more letters that serve as guide letters. These letters tell you which cards can be found in that particular drawer.



There are basically three types of **catalog cards**. These are called "**author cards**", "**title cards**", and "**subject cards**". On each of these cards is found considerable information. Samples of each of these cards are found on the next page. Please note the information found on each.

SAMPLE OF SUBJECT CARD



SAMPLE OF TITLE CARD

599.74	The world of the polar bear
P464W	Perry, Richard, 1909-
	The world of the polar bear by Richard Perry
	1st U. S. ed. Seattle University of Washington press 1966.
	195 p 8 plates, map 22cm
	Bibliography: p 179-185

SAMPLE OF AUTHOR CARD

599.74	
P464W	Perry, Richard, 1909-
	The world of the polar bear by Richard Perry
	1st U. S. ed. Seattle University of Washington press 1966.
	195 p 8 plates, map 22cm
	Bibliography: p 179-185

As you can see, the three sample catalog cards pertain to the same book. There are, however, three different "headings" you could have looked under to find this book on polar bears. If you do not know the title of a book, but you know what subject you are interested in, or the name of an author noted for work in that area, you have at least two options open to you in terms of searching for an appropriate book. This strategy is known as "cross referencing". Of course, if you know the exact title of the book you are looking for, you are all set. But, how many times will you know exactly the book for which you are looking?

Some libraries have separate card catalogs for each type of card. Other libraries, however, often combine the three cards in one or two catalogs.

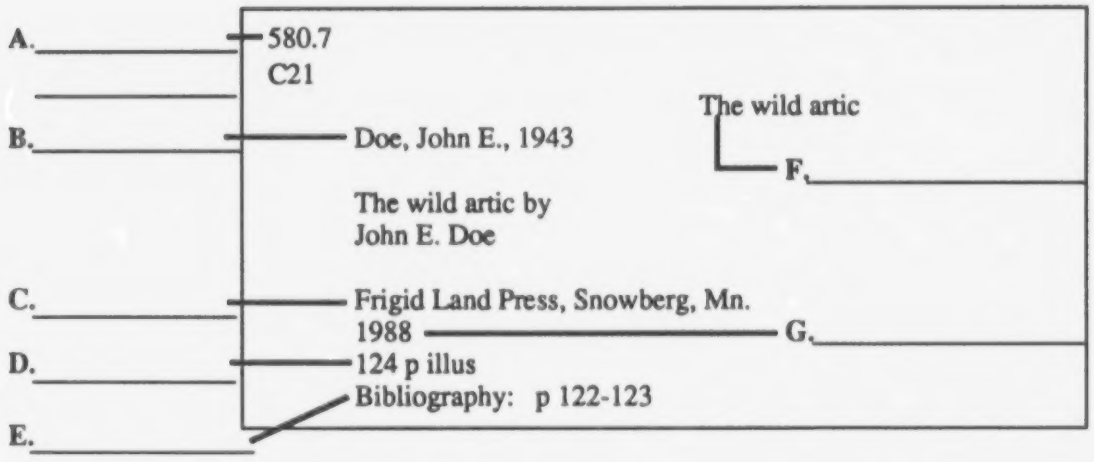
Assume that you have found the card that is meaningful in your search for information. How do you find the book? Books are usually arranged on the library shelves according to the Dewey Decimal System - books are broken down in this arrangement according to ten (10) main classes. They are as follows:

000-099 - General works and reference materials (e.g., encyclopedias)
100-199 - Philosophy, psychology
200-299 - Religion
300-399 - Social Studies
400-499 - Languages
500-599 - Sciences, mathematics, geology, botany, zoology, etc.
600-699 - Applied arts and sciences such as medicine and engineering
700-799 - Fine Arts such as art, music, recreation, etc.
800-899 - Literature such as novels, poetry, essays, drama, etc.
900-999 - History, geography and travel

The call number on the catalog card will help you locate your book. The first three numbers will tell you to which "class" your book belongs. The book on polar bears was numbered 599.744. This means that it belongs to the "500" class or the one dealing with the sciences. You would simply locate the area in the library in which the "500" books are shelved and search for 599.744. The shelved books will be arranged in numerical order. This means, for example, that a 586 book will be shelved in front of the 599.744 book for which you are looking.

Looking Back at Catalog Cards. Let's see how much you remember about the data found on cards in the card catalog. Respond to the two questions below and then fill in the blanks which surround the model card designed for this purpose. (II-12)

1. What kind of card is the one on the next page?_____
2. In what area of the library would this card be found?_____

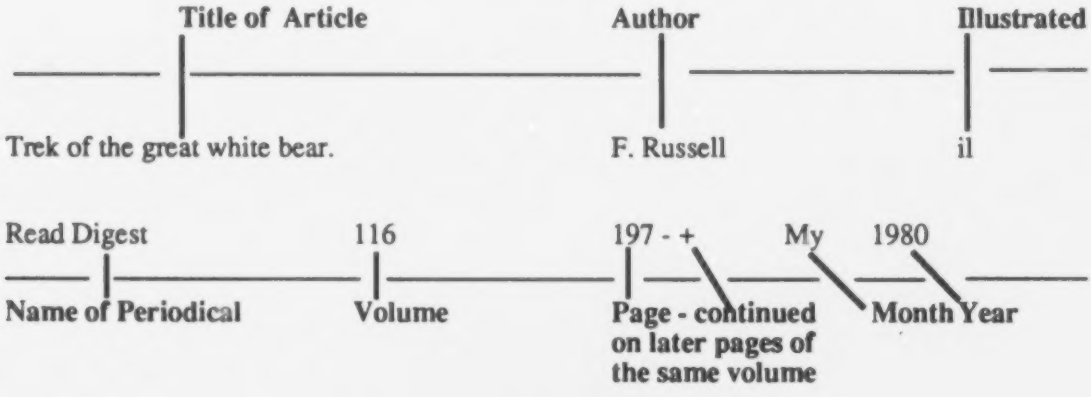


Library Skill 2: Using the Readers' Guide

Many times you may not be able to locate books that pertain to a particular topic - or, you might not be able to locate enough information in books. What do you do then? If this becomes a problem, do not discard the topic for research. Chances are you can find a good deal of information by using another source - **The Readers' Guide**.

Using The Readers' Guide is not at all difficult once you get the hang of things. This publication is actually a series of books that contain listings of articles published in periodicals. (Periodicals are magazines published at different intervals - monthly, bi-monthly, etc.) The articles found in The Readers' Guide are classified alphabetically according to subjects. The entry following deals with bears. Note the information you can get from this entry.

Subject Bears



At the beginning of each volume of The Readers' Guide there are explanations to help you interpret the information you will find in each listing.

The final step would be to take the information concerning the articles listed in The Readers' Guide and go to the periodical section of the library and find the actual articles (assuming that the library in which you are working keeps those particular periodicals). Periodicals are arranged on the library shelves alphabetically and then in numerical order according to the volume number.

Cross Indexing - The Readers' Guide

Occasionally you may have a difficult time locating reference materials if you do not understand cross indexing. **Cross indexing** is a term that refers to **locating reference materials on a particular topic by looking under the "headings" of related topics**.

Let's assume that you need to locate information regarding solid waste disposal. You go to The Readers' Guide in the library and find that there is not a single article under the heading, "Solid waste disposal". However, there is a note which suggests that you look under "Refuse and refuse disposal". You then look under this heading and find, just to mention a few:

Food waste is energy waste. A. Borghese. bibl Environment 23: 2-4 Jl/Ag '81

No room at the bin (solid waste disposal). J. Marinelli and G. Robinson. il
Progressive 45: 22-27 D '81

Telltale litter (opinions revealed by littering behavior). C. Rubenstein.
Psychol Today 15: 19-20 D '81

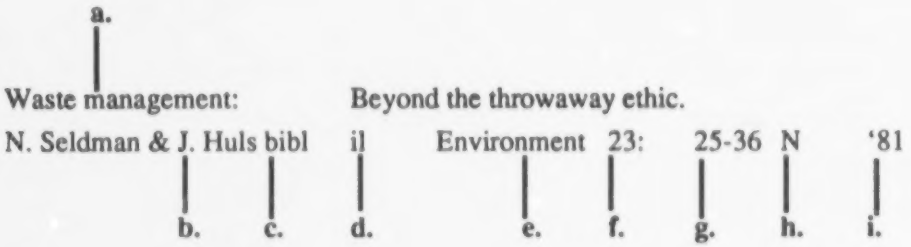
Waste management: Beyond the throwaway ethic. N. Seldman and J. Huls. bibl il
Environment 23: 25-36 N '81

There are many other articles also listed under this heading. You might feel that this is great! It is, but don't stop there. You will often find further cross indexing aids under a particular heading. Using the example above, you would find the following suggestion (to mention a few) under the heading, "Refuse and refuse disposal".

See also:
Incineration
Refuse containers
Waste disposal in the ocean
Water pollution

If you were to look under each of these new headings, you would quite possibly find a number of articles pertaining to the topic you are investigating.

Looking Back at The Readers' Guide. Let's see what you remember in terms of the written material and symbols used in The Readers' Guide. Below, you will find repeated one of the references listed above. Fill in the blanks with the appropriate information and ask your instructor to check your responses. (II-13)



a. _____ f. _____

b. _____ g. _____

c. _____ h. _____

d. _____ i. _____

e. _____

Researching for Keeps: An Example

How you go about the task of doing research using secondary sources is largely determined by the topic, the questions needing answers, and your knowledge and skill as a researcher. What follows is an example of a research report completed by a student on the topic of polar bears. The major question posed in this research deals with whether the polar bear is an endangered species. Other minor questions have also been answered via this research, e.g., what is the life cycle of the polar bear?

The authors are presenting this report as a model of secondary research but they also want you to think critically about the quality of the research report and the bibliography at the end. You will be asked to complete a few tasks relative to it when you have finished reading the report.

THE POLAR BEAR: AN ENDANGERED SPECIES?

Are polar bears an endangered species? Should we be concerned about the conservation of these animals. Is it already too late? Is anything being done today to protect the polar bear? Before we attempt to answer these questions intelligently, we should first look at the general characteristics of the polar bear and some of the known facts about this species.

Thalarctos maritimus is the scientific name for the polar bear. This name means "sea bear". The name is quite appropriate as the polar bear is an excellent swimmer. Its color usually varies from a light yellow to a creamy white. A full grown bear may be up to nine feet tall (when standing on its hind legs) and weighs up to 1600 pounds. However, the average weight is about 900 pounds.

The polar bear usually hunts over a large area unless there is a suitable amount of food available in a small area (e.g., a dead whale up on the shore). This mammal is perfectly willing to act as a scavenger at these times but the polar bear is usually thought of as a meat eating predator, at least during the winter months. Its carnivorous diet consists mostly of seals, baby walruses, stranded whales, fish, and occasionally lemmings and mice.

Near July, when many of the icebergs have melted, the polar bear changes its carnivorous diet to one that is mostly vegetarian. It now seeks grasses, sedges, sorrel, seaweed, and berries. During these warmer months, the polar bear also hunts lemmings, eider ducks and snow geese. Although they may not always capture their prey, the bear will often feed on the eggs of ducks and geese.

The life expectancy of the polar bear varies greatly. At Regent's Park Zoo in London, a polar bear lived for 40 years. However, the life span of such a bear in the Arctic is usually much shorter.

The female polar bear becomes sexually mature at the age of four. She almost always mates in April, but does so only once every three or four years. When winter approaches, the pregnant polar bear digs a den in which to have her cubs. The gestation period is nine months. Most cubs are born in early December. If it is the first offspring of the sow (the female bear), it will often be a single cub. After the first birth, the sow almost always has twins and occasionally triplets.

Cubs are usually blind, lack fur, and are deaf at the time of birth. Newborn babies weigh about two pounds and are approximately ten inches long. Sometime in March and April, the sow digs out of the den. The cubs are partially weaned by mid-July. At this time, they feed on seals killed by their mother. Until they learn to kill bigger game, their diet is supplemented only by crabs, shellfish, and seaweed. The cubs must be nurtured 18 months after birth in order to survive. They weigh close to 400 pounds when their mother leaves them to fend for

themselves.

Polar bears remain a great mystery to man. This is due to the fact that there is little research data regarding the natural history of this bear. Research is hampered by adverse weather conditions and the lack of tracking methods for following these wandering animals.

The first actual field work was accomplished by C. R. Harrington of the Canadian Wildlife Service in 1961. The Manitoba and Ontario governments followed with aerial surveys in 1962 and 1963, respectively. Worldwide attention then began focusing on the plight of the polar bear. In 1965, the First International Scientific Meeting on the Polar Bear was held in Fairbanks, Alaska. This meeting was attended by the five polar bear countries concerned about the polar bear (i.e., Canada, Denmark, Norway, U.S.S.R., and the U.S.A.). At this meeting, these nations discussed protection of cubs and females, cooperation of research, and the need for an expanded study program. More extensive research has since begun and has improved consistently by immobilizing the bears with a harmless drug shot from a gun. After the bears are immobilized, they are tagged and studied in detail.

Although far from complete, research has indicated some interesting points. People had generally accepted the idea that polar bears wander over the entire polar region. However, preliminary evidence from "tagged" bears suggests that the polar bear is not circumpolar. There may also be separate regional races of bears. If this is found to be correct, each interpolar country could manage its own polar bear population. Another interesting and alarming aspect about the polar bear is that they have been found with traces of DDT and other pesticides in their bodies - thousands of miles from where these chemicals had originally been used.

Many important questions remain unanswered. scientists still do not fully understand how polar bears can survive temperatures as low as -65 degrees F. Nor do they thoroughly understand the movements of the bear throughout the year, the longevity of bears in the wild, the distinctness of bear populations, or even how many polar bears there are remaining in the world. The origin of the bear population off the northeast Alaska coast is still a mystery because no large maternity-denning areas have yet been located in Alaska.

The polar bear appears to have many enemies with which to contend. They can suffer from foot infections, broken bones, arthritis, and even tooth decay in older individuals. A hungry bear will sometimes kill another bear for food. Wolves and large walruses kill a few polar bears each year. Slowly, over a long period of time, the arctic temperature has become warmer and this may be shrinking the polar bear's habitat.

At the top of the polar bear's enemy list is man. Due to increases in human population and the demand for more power and natural resources, man is being forced to explore and develop that part of the world which was once the kingdom of the polar bear. Seal hunters make serious inroads on the polar bear's food supply. And, as seal supplies diminish, many hunters turn to

"ENDANGERED, HECK! I'LL BE GLAD WHEN THEY'RE EXTINCT!"

killing the polar bear. The polar bear's population plight is worsened by high prices on polar bear skins, trophy hunters, and tourist-trade-hungry countries. In fact, between the years of 1940 and 1971 the number of bears killed increased from 148 per year to well over 1300 per year.

Wildlife biologists and conservationists fear that the polar bear is in real danger of becoming extinct. It is estimated that there are only between 5000 and 20,000 polar bears alive in the world today. If the number of kills was allowed to increase, the polar bear could become extinct in a relatively short period of time. It must be remembered that the reproductive capacity of the bear is extremely limited. There is no way that polar bears can increase their reproduction at the same rate that hunting pressure is increased.

The five polar bear countries concerned with this problem have made varying degrees of effort in producing laws pertaining to the hunting of the polar bear. In 1965, the U.S.S.R. banned all hunting of the polar bear. Recently, set guns and trophy hunting were banned in Canada. The

International Union for the Conservation of Nature and Natural Resources, located in Switzerland, has placed the polar bear in its "Red Data Book" (a widely recognized official list of the world's rare and endangered species). The United States' two most influential hunting groups, the Boone and Crockett Club and the National Rifle Association, no longer offer rewards of recognition for the shooting of a polar bear. No hunting of polar bears by whites is allowed in Manitoba. However, the Eskimos now have snowmobiles and are able to hunt these bears more efficiently. Possibly the reason for these different laws is the overall uncertainly of the polar bear population and its natural history. It now appears that the polar bears of Labrador may almost be extinct. Only on the west coast of Hudson Bay do they seem to be on the increase.

The conservation and/or management of a natural resource refers to the wise use of that resource. The extent to which the polar bears can be hunted appears to be a very real problem.

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Analyzing the Research Report (II-14)

1. The writer of this research reports that a young polar bear weighs up to 400 pounds when it is weaned by its mother. Other references, however, state the weight at 200 pounds. How might the writer have checked this conflicting information? Of course you're right, he might have decided to write for expert information. Where might this letter be sent?

_____

_____

2. In the first paragraph of the research report, the writer asked whether it was too late to save the polar bear from extinction. Yet, he didn't answer that question in the report. Why?

_____

_____

3. Is there any indication in the research report on polar bears as to what the writer's own values are concerning the management of this animal?

Yes _____ No _____ Cite evidence to support your answer

_____

_____

4. Do you believe that the person who researched the management of polar bears did a good, thorough job? Yes _____ No _____. Cite evidence to support your own position on this.

_____

_____

_____

_____

_____

_____

_____

_____

MODULE III

USING SURVEYS, QUESTIONNAIRES, AND OPINIONNAIRES IN ENVIRONMENTAL INVESTIGATIONS

Several different research methods can be used to study environmental issues on a first-hand basis. Three of these methods are surveys, questionnaires, and opinionnaires. In this module you will be introduced to each of these. You will study the rules governing the use of surveys and questionnaires. You will learn to distinguish between the three research methods introduced in this module. You will be introduced to some of the rules you should follow as you sample populations of people. Most important of all, you will probably get a chance to do research using at least one of these methods. You should find this interesting so let's get started.

Objectives for Module III

Upon the completion of this module, you will be expected to be able to . . .

1. ...name several environmental issues which lend themselves to gathering information using surveys.

2. ...name several environmental issues which lend themselves to gathering information using questionnaires.

3. ...name several environmental issues which lend themselves to gathering information using opinionnaires.

4. ...prepare a list of rules that should be respected when developing surveys, questionnaires, or opinionnaires.

5. ...identify, from a list of ten (10) research questions, those items which are basically surveys, those which are questionnaires, and those which are opinionnaires.

6. ...explain why studies done using questionnaires and opinionnaires are really special kinds of surveys.

7. ...identify an issue of local concern and make a list of the information that needs to be collected during an investigation of that issue.

8. ...communicate the basic rules associated with sampling populations of human beings.

9. ...plan for and conduct a research study which focuses on the use of a survey, questionnaire, or opinionnaire. In addition, successfully communicate the data collected during that research.

Surveys

A survey is one method that can be used to collect information about certain environmental problems. The survey can be a direct means of investigating something in or near your community. How valuable it will be depends entirely on how you go about it and the quality of the data you collect.

A survey collects information. In the dictionary you will find a definition for **survey** something like the following:

> **Survey:** A critical inspection used to provide exact information. Often, a study of an area with respect to certain conditions.

This simply means that a survey looks for very specific information in a very particular area. The key words are information and area. Consider the following survey examples:

1. The number of leaky faucets in a given school building.
2. The number of empty junior high school classrooms in which the lights have been left on during a given day.
3. The amount of food-related litter found within a four block radius of a local fast food restaurant.
4. The number of abandoned cars in a particular neighborhood or township.
5. The number of returnable and non-returnable beverage containers sold over a particular time period in a local grocery store.
6. The temperature at which public buildings are kept during the month of January.
7. The number of young bluebirds raised over a one year period from nest boxes installed on a particular farm.
8. The amount of food wasted in a one week period in the school cafeteria.

Did you note in each of the examples what is being surveyed and where the survey is to take place? You should be ready to think of some environmental conditions that you could survey. Try your hand at listing two good environmental surveys in the spaces below. (III-1)

1. _____

_____

2. _____

_____

You are now ready to examine a model survey. This survey includes: (1) the research questions, (2) the survey procedures, (3) a data grid, and (4) a summary analysis sheet. This package represents all the necessary components to successfully compile information about an environmental issue (or a suspected issue). The research questions specify exactly what information is to be examined. The data grid is a method of accurately recording that information. The summary analysis sheet organizes the results of the survey.

MODEL SURVEY

A Neighborhood or School Survey of Trees and Shrubs

Survey (Research Questions):

1. How many trees and shrubs exist in a given block or on the school site.

2. Where are these trees and shrubs located?

3. What kinds of trees and shrubs have been planted here?

Survey Procedures:

1. Carefully choose a block, neighborhood, or school site to be surveyed.

2. Plot the locations of trees and shrubs using the Survey Grid found on the next page.

   (Note: You should make certain that the dimensions of your grid correspond to the area chosen for the survey. The grid provides for a square block and shows curb strips. This may or may not be suitable for your purposes. Symbols can be used for various kinds of trees and shrubs and suggested symbols are found at the bottom of the page on which the Survey Grid is located.)

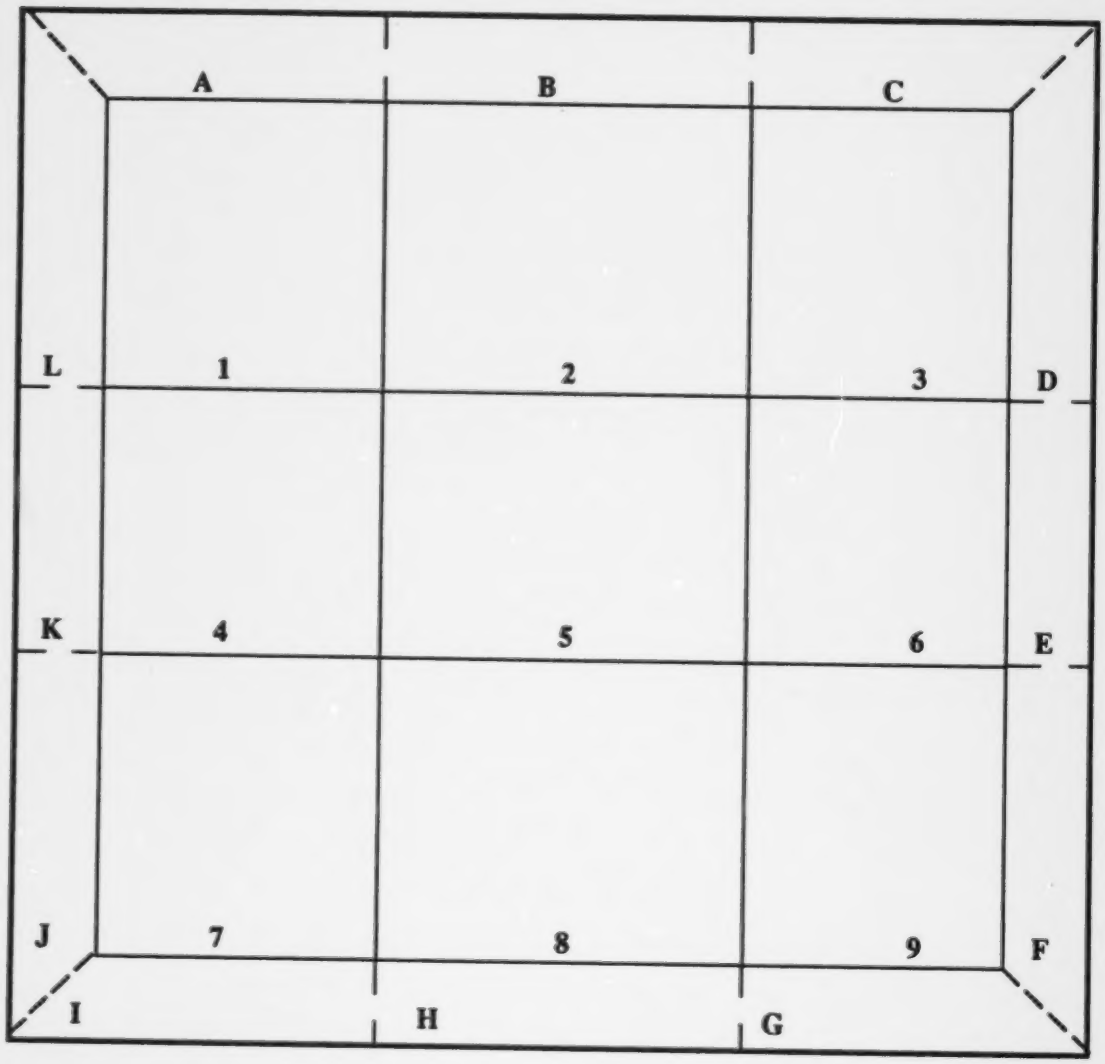
3. Record the data collected on the Data Summary Sheet. If this Data Summary Sheet does not meet your needs, design a new one.

4. Carefully consider the implications that this kind of survey could have on a neighborhood, on a school site, or on wildlife populations. That is, of what value could such a survey be?

Neighborhood Survey Grid
Data Sheet

Exact site of survey: _____

Date of Survey: _____



Symbols:

X = _____ # = _____ S = _____

+ = _____ Ø = _____ V = _____

O = _____ * = _____ Z = _____

DATA SUMMARY SHEET

Survey of Trees and Shrubs

	Kinds of Trees and Shrubs																				
Grid Component-Read Down																					
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
A																					
B																					
C																					
D																					
E																					
F																					
G																					
H																					
I																					
J																					
K																					
L																					
Sub Totals																					

Questionnaires

A questionnaire is a special kind of survey. It can be used to collect information that can only be obtained in this manner. A definition can be found below:

> **Questionnaire:** A carefully written set of questions about a particular subject that is given to a carefully selected sample of human beings.

It is critical to note that questionnaires collect only hard, cold data, i.e., facts. They do not collect opinions people have about something. Consider the examples below.

1. Number of children per family unit in a particular neighborhood or community.
2. Number of gasoline powered devices owned per family in a neighborhood or community.
3. Types of heating systems found in a particular neighborhood or community, e.g., natural gas, bottle gas, fuel oil, electric, coal, wood.
4. Garbage disposal techniques used by renters and/or home owners.
5. Number of home owners/renters recycling metal containers.
6. Average number of pets being fed by residents in a particular neighborhood or community.

Can you think of two other topics of an environmental nature that could be studied using a questionnaire? Remember to specify the particular subject topic and identify the target population. (III-2)

1. _____

_____

2. _____

_____

A questionnaire is really a special kind of survey. It requires information that can only be supplied by human beings. Thus, each research question for a questionnaire must specify a target population (or sample of a population). Reread each of your responses to make sure both the **topic** and the **target population** are included.

Now, please examine the model questionnaire and the data summary sheet on the next page.

Model Questionnaire

Glass and Metal Waste Questionnaire

This questionnaire is designed to yield usable data concerning the habits people have relative to their use and disposal of glass and metal containers. It should be used with a member of a household, preferably the person responsible for household management. If this questionnaire is used, the size of the sample gathered should be fairly large in order to make the data meaningful, i.e., over 70 responses. Similarly, it is suggested that data be collected and categorized (tabulated) according to particular parts of the community, i. e., high income, middle income, and low income neighborhoods.

Hello, my name is _____ I am a student at _____.
One of my classes is doing research in environmental problems and I would like to ask you a few questions about your use of glass and metal containers. May I ask you a few questions?

Person Responding: ☐ Male ☐ Female

☐ Neighborhood A ☐ Neighborhood B ☐ Neighborhood C

1. How many people live in this household? ..... _____
2. Do you purchase any part of your groceries (other than beverages like pop, fruit juice, or beer) in metal containers? ..... Yes ___ No ___
3. Do you purchase any of your beverages in metal containers? ..... Yes ___ No ___
4. Do you purchase any beverages in glass containers? ..... Yes ___ No ___
5. Of those beverages purchased in glass containers, what percent of the beverages are in returnable glass containers? ..... _____%
6. What percent of metal cans purchased do you recycle? ..... _____%
7. What percent of glass throw-away containers purchased do you recycle? ..... _____%
8. Have you (or any member of your family) ever asked your grocer to stock beverages in reusable glass containers? ..... Yes ___ No ___

Thank you very much for your help!

Glass and Metal Questionnaire Data Summary Sheet

ITEM	Population or Neighborhood A.		Population or Neighborhood B.		Population or Neighborhood C.		Totals	
No. of Males Responding								
No. of Females Responding								
Average No. of People per Household								
Groceries (Not Beverages) Purchased in Metal Cans	Yes	No	Yes	No	Yes	No	Yes	No
Beverages Purchased in Metal Containers								
Beverages Purchased in Glass Containers								
% of Glass Resuable =								
% of Glass Thrown-away =								
% of Cans Thrown-away =								
% of Cans Recycled =								
% of Throw-away Glass Thrown Away =								
% of Throw-away Glass Recycled =								
Has any member of the family requested a grocer to stock beverages in resuable glass containers?	Yes	No	Yes	No	Yes	No	Yes	No

Opinionnaires

Opinionnaires are like questionnaires except for one major difference. Opinionnaires measure opinions or beliefs of human beings concerning specific things. Consider the following examples:

1. Should auto emissions be tested regularly by local or state governments?
2. Will legislation placing a deposit on beverage containers be supported by the public in Illinois?
3. Should stricter controls be placed on the import of exotic animals to be sold in pet stores?
4. Are farmers in Indiana in favor of economic incentives which would promote erosion reducing farming practices?
5. Do high school students in Los Angeles believe that they contribute to air pollution in any way?
6. Do coal miners in Kentucky believe that acid rain causes important environmental damage?
7. Should the federal government assist citizens made ill by toxic wastes?

You can easily see that all of the questions above deal with how people feel about something or, their opinions about something. Now, let's see whether you have the idea. Think about local, regional, or national environmental issues about which you could get opinions of people. Write two of these below: (III-3)

1. _____

_____

2. _____

_____

Evaluate your questions to make sure they deal with opinions or beliefs. Then examine the model opinionnaire and the data summary sheet that follow. This example should improve your understanding of the nature of opinionnaires.

Model Opinionnaire

Opinions on Littering

This opinionnaire is designed to collect information on the opinions citizens have concerning littering. It is suggested that samples be drawn from several segments of the population, e. g., junior high students and adults. Data collected should be reported for specific samples. The opinionnaire is set up so that it should be read to the person being surveyed. A minimum of seventy (70) persons per sample is recommended.

Hello, my name is _____. I am a student at _____ School. One of my classes is collecting information about how people feel about littering. May I collect information from you? (If the answer is "yes" continue.)

Person Responding: ☐ Male ☐ Female

Questions:

1. To what extent do you consider the littering of public and/or private property to be a problem in this community?

1	2	3	4	5
Not At All		A Moderate Extent		A Great Extent

2. In your opinion, to what extent does littering have any harmful effects on the beauty or aesthetic quality of this community?

1	2	3	4	5
Not At All		A Moderate Extent		A Great Extent

3. In your opinion, to what extent does littering pose any public health problems for this community?

1	2	3	4	5
Not At All		A Moderate Extent		A Great Extent

4. In which of the following places in the community do you think littering is at its worst?

___A. The schools?
___B. The streets?
___C. Shopping centers?
___D. Other businesses, i. e., gas stations and drive-ins?
___E. Private property?

5. What age person do you believe is the most responsible for littering?

___A. Students below junior high age?
___B. Students of junior and senior high age?
___C. College age citizens?
___D. Citizens over age 21?

6. Which of the following statements concerning law enforcement do you agree with most?

_____ A. Law enforcement officers should ignore people who litter.

_____ B. Law enforcement officers should enforce anti-littering laws only in cases of severe littering.

_____ C. Law enforcement officers should enforce anti-littering laws strictly to the letter of the law.

7. Would you ever consider reporting a severe case of littering to the police? ..... Yes ___ No ___

8. Have you ever reported a severe case of littering to the police? ..... Yes ___ No ___

9. Do you wish that fewer people would litter? ..... Yes ___ No ___ Undecided ___

10. In your opinion, what do you feel is the most important reason for the litter problem as it exists today?

_____

_____

_____

_____

_____

_____

_____

THANK YOU FOR YOUR HELP!

LITTERING OPINIONNAIRE
Data Summary Sheet

Sample Being Reported: Number In This Sample _____
Junior High Sample: _____. Person(s) Collecting These Data:
Senior High Sample:_____ _____
Adult Sample _____ _____
Other: _____ _____

		Males	Females	Total
Question 1.	Extent 1:	_____	_____	_____
	Extent 2:	_____	_____	_____
	Extent 3:	_____	_____	_____
	Extent 4:	_____	_____	_____
	Extent 5:	_____	_____	_____
Question 2.	Extent 1:	_____	_____	_____
	Extent 2:	_____	_____	_____
	Extent 3:	_____	_____	_____
	Extent 4:	_____	_____	_____
	Extent 5:	_____	_____	_____
Question 3.	Extent 1:	_____	_____	_____
	Extent 2:	_____	_____	_____
	Extent 3:	_____	_____	_____
	Extent 4:	_____	_____	_____
	Extent 5:	_____	_____	_____
Question 4.	Response A:	_____	_____	_____
	Response B:	_____	_____	_____
	Response C:	_____	_____	_____
	Response D:	_____	_____	_____
	Response E:	_____	_____	_____
Question 5.	Response A:	_____	_____	_____
	Response B:	_____	_____	_____
	Response C:	_____	_____	_____
	Response D:	_____	_____	_____
Question 6.	Response A:	_____	_____	_____
	Response B:	_____	_____	_____
	Response C:	_____	_____	_____

Question 7.	Yes:	Males _____	Females _____	Total _____
	No	Males _____	Females _____	Total _____
Question 8.	Yes:	Males _____	Females _____	Total _____
	No	Males _____	Females _____	Total _____
Question 9.	Yes:	Males _____	Females _____	Total _____
	No	Males _____	Females _____	Total _____
	Undecided	Males _____	Females _____	Total _____

Question 10. Summary of Reasons:

_____

_____

A Self-Test

After the introduction you have had to surveys, questionnaires, and opinionnaires you should have a fairly good idea of what each is. In this test you will find ten questions. Read each carefully. Place an **S** in front of the question if it represents a survey, an **O** if it represents an opinionnaire, and a **Q** if it represents a questionnaire. (III-4)

_____ 1. How many acres of park space are set aside for each resident in this community?

_____ 2. Should wandering packs of dogs be allowed to roam the neighborhoods in this community?

_____ 3. Do the citizens of this community prefer having a tree and house decoration contest at Christmas (with lights) or would they prefer to conserve the electricity used in such an effort?

_____ 4. Do members of families in your community contribute to any conservation organizations? If yes, which organizations?

_____ 5. How many faucets in your school building drip water? How much water is lost (in gallons) per month or per year? What is the cost?

_____ 6. What type of refuse disposal does your community have, e.g., open dumps, sanitary landfills, controlled incineration, or some other?

_____ 7. If the rat population in your community increased, would you be willing to accept a tax increase in order to eliminate the rats?

_____ 8. How many areas on the school grounds show signs of soil erosion? How many of these could be improved with the planting of ground cover?

_____ 9. Should the recycling of glass and metal waste be made mandatory even if it is currently unprofitable?

_____ 10. How much money is spent per month on pet food in your community?

Correct responses are found at the end of this module.

A variety of illegal dumps can be found in many parts of the United States. This particular dump is located at the edge of a sugar cane field in Hawaii. If you were to investigate illegal dump sites in your area, what kind of an instrument would you use? Photo courtesy H. Hungerford.

Using Combination-Type Instruments

Sometimes, when conducting an investigation, it is necessary to ask questions and gather opinions from the same people. This means that you will need to develop a combination questionnaire/opinionnaire. There is nothing at all wrong with this strategy as long as it is necessary for your research. Still, it is very important for you to understand why you need both kinds of information and to recognize the difference between questions and opinions.

Sometimes the researcher will need two separate instruments for a particular research study. For example, a researcher conducting a study on solid waste disposal in a particular community may have a need for expert testimony as well as the opinions of residents. In this case, the researcher may have to develop an interview that can be used with experts on solid waste as well as an opinionnaire that can be used with residents. In this way, the researcher can collect facts concerning solid waste disposal from experts as well as the opinions of residents on the topic. Again, there is nothing at all wrong with this strategy as long as the researcher understands the difference between expert testimony and the opinions of residents who may or may not be experts on solid waste.

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What Are Some of the Basics of Sampling?

You will recall that, early in this module, we spoke of "sampling" a population in order to collect data. What is a "**population**" and a "**sample**"? How does one go about sampling a population? Is it important to be careful? Are my data better if careful sampling techniques are used?

When using questionnaires and opinionnaires a researcher has to contact people. These people usually represent a population of human beings who are somehow associated with what you are investigating. They could be residents of a particular neighborhood, or a county, or a state. They could also be members of certain organizations or racial groups or even certain age groups. The **population is all of the people in the group** you are interested in. Now, if the population is small enough, you can go to all of the people in that population. However, this is often not the case. This means that you will have to somehow select a smaller part of that population. This **smaller part becomes a sample**.

How you select your sample is very important. Why is that the case? In order to get answers which represent what all kinds of people in a population are thinking, you need to contact all those different kinds of people. In that way, your sample will represent the views of the larger population. This becomes what we call a **representative sample**.

One question that is often asked relates to how many people must be included in a sample. This is a tough question to answer. Typically, if you want to get scientifically accurate information from a relatively small number of people, you should try for at least 70 people in your sample. If the number of people in your population is very large, you may want to collect data from more than 70!

Often times you just don't have the money or time to get 70 responses. If this is the case, you can obtain fewer sample members but you must somehow try to get enough responses so that all views are represented.

Here an example would help. Suppose you wanted to know what the adults in your county thought about a new landfill being created in one part of the county. Would you contact only people living close to the proposed landfill? Or, would you contact only people in your own community (who are not close to the proposed landfill)? If you really wanted opinions of all concerned, you would have to contact people in both areas (and others as well).

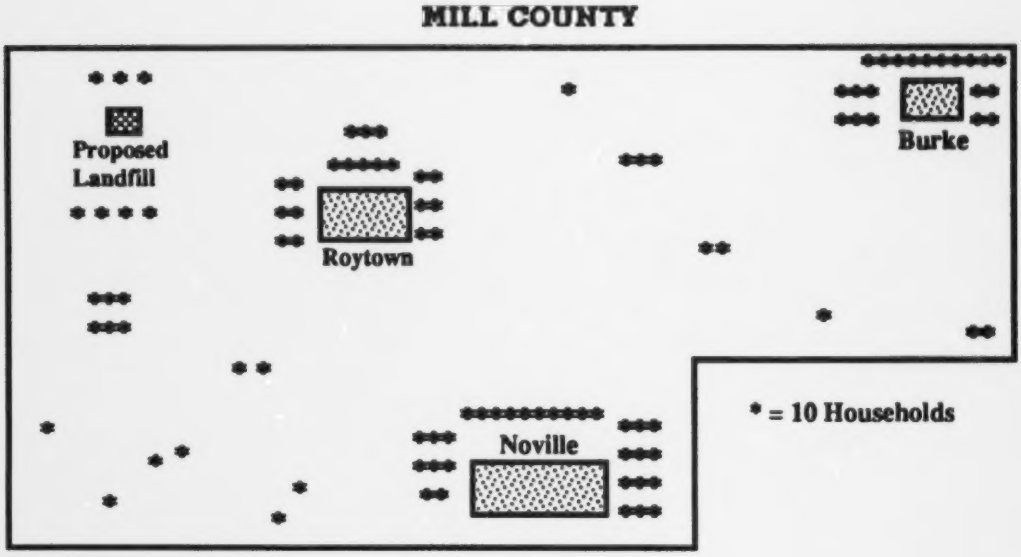
Random Samples

Now, how do you go about sampling a population? Most experts will tell you that your sample should be random. A random sample is one in which all viewpoints have an equal chance of being represented. Thus, there is no scientific bias in the sample. This may sound like a difficult thing to accomplish, but there are some very simple ways to get a random sample. For example, on the next page you will see a map of Mill County and the households in that county. You will notice that there are 1000 households in Mill County (Note: each asterisk represents 10 households). Two hundred households are located in Burke (20% of the households in the county). Three hundred households can be found in Noville (30% of the households in the county). Roytown contains 200 households (20% of the households in the county). And 300 households are located in the rural areas of the county (30% of the households in the county).

Let's suppose that the officials in Mill County wanted to put a new landfill (sometimes called a waste disposal dump) in the northwest corner of the county. Let's also suppose that you are interested in collecting data on residents' opinions about the location of the proposed landfill. How might you go about doing this? It might make sense to question one individual from each of 70 different households in Mill County. Your population would include all 1000 households in Mill County. Your sample would include 70 of the 1000 households in Mill County. Another way to say this is that your sample would include 7% of the households in Mill County. The information with the map gives you two suggestions for randomly sampling 7% of the Mill County households.

Systematic Samples

Another way to select your sample would be to use a systematic method of sampling the population. A systematic sample is not as desirable as a random sample! However, it is probably acceptable in most cases. The systematic method consists of selecting your sample using a system. For example, a systematic sample of your classmates might be every fifth name from an alphabetic listing of all your classmates' names. Not every individual would have an equal chance of being selected. In fact, each person's chance for being selected would depend on what letter of the alphabet his or her last name begins with! If you turn again to the map of Mill County, you will see an example of how you might get a systematic sample of Mill County households.



Four Methods For Sampling Mill County Households

Random Sample: List all households....Number them from 1 to 1000....Put these numbers on separate slips of paper....Place the slips in a container. ...Draw 70 slips

Result: Seventy (70) households randomly selected from the entire county.

Random Sample: List the households in Burke. ...Number them. ...Put these on separate slips of paper. ...Place the slips in a container. ...Draw 7% of the slips from the container (7% of 200 = 14 households). ...Next, do the same thing for the households in Noville (7% of 300 = 21 households), Roytown (7% of 200 = 14 households), and in the rural areas (7% of 300 = 21 households).

Result: Fourteen households randomly selected from Burke; 21 randomly selected from Noville; 14 randomly selected from Roytown; and 21 randomly selected from the rural areas. This totals 70 households in Mill County.

Systematic Sample: Obtain a list of the households in Mill County. ...There are 1000 households and you wish to identify 70 of them. ...Divide the total number of households by the number you wish to identify (1000/70 = 14). Select every 14th household.

Result: Seventy (70) systematically selected Mill County residents.

Sample of Convenience: Distribute 70 instruments to "heads of households" attending a Mill County church (or some other group of 70 or more adults).

Result: Seventy (70) church goers in Mill County.

Samples of Convenience

Sometimes researchers cannot get a random sample or a systematic sample of a population. Sometimes they are unwilling to spend their time and energy to get one. In these cases, the researcher may choose to use samples of convenience. A sample of convenience is made up of people that the researcher can easily contact. For example, in the Mill County opinionnaire, if the researcher lived in Noville, he/she might choose to sample only the households in Noville. The problem with samples of convenience is that they often only reflect the viewpoints of certain members of the larger population. In this example, the folks in Noville would probably have far different opinions than those living close to the proposed landfill site. Can you see what kind of problems this poses for the researcher?

Interviews

Sometimes a researcher will choose to interview a limited number of people who are closely associated with an environmental issue. In this case there are a couple of things that are quite important. First of all, the interview must be a thorough one, i.e., it must get all of the information which is important to the study. Secondly, the researcher must attempt to interview those who are really knowledgeable about the issue.

In the Mill County landfill issue, for example, a researcher might wish to use an interview to obtain specific facts about the proposed landfill from experts. He or she might go to sanitary engineers, waste disposal people, county officials, EPA officials, and even scientists at the state Geological Survey to get very specific data from important players in the issue. Here, the researcher is attempting to interpret the issue in a far different way than with an opinionnaire. This is an entirely different kind of research study, but it still deals with the same issue - that of the proposed landfill in Mill County.

When a researcher uses interviews, he or she will still prepare a set of questions which attempts to collect factual information or opinions. However, the questions will probably be fewer in number and will collect indepth information. In addition, the sample will be much smaller.

Data Collection Techniques

Several techniques for data collection are available to the researcher. Once you have decided on your population and sampling technique(s), you might choose to mail your survey to sample members. You might choose to use a telephone survey. If your area is small enough, you may simply distribute your instrument yourself. Sometimes a researcher must be very creative in finding a good way to collect needed information. Whichever technique you finally decide on, it is an excellent idea to approach your sample members in a polite and pleasant manner. This will probably help you get the maximum amount of information for your study.

Oh Ben, do you think that pelican has an opinion on oil spills?

Let's Summarize

A good way to investigate environmental issues is to collect information with surveys. Surveys are aimed at a specific kind of information in a certain area. Sometimes information can only be obtained from human beings. A questionnaire is a survey asking human beings for information. An opinionnaire is a survey asking for human beliefs and opinions.

Since you have been introduced to surveys, questionnaires, and opinionnaires, it is time to practice using them. Your task for this part of the module is to work as a class to plan, write, and use one type of survey, i.e., a survey, questionnaire, or opinionnaire. The teacher, along with you and your classmates, may choose to use one of the survey models presented earlier. However, it is also possible that an entirely new one will be developed.

First, it is necessary to discuss a limitation of this module. This module will help you to set up and use your survey to collect data. But that is only part of the task. Another part is to interpret the findings (i.e., the data you collect). The process of data interpretation will be presented in Module IV. The focus of this part of Module III will be to collect good data for interpretation.

Your first task is to assist your instructor and your classmates in choosing a local environmental issue for investigation. For example, you might think that the litter from fast food restaurants is a local problem. Because this is a practice activity, make your choice simple and straightforward. Working on your own, think of a local environmental issue and write your choice below for the local environmental issue which you would like to investigate.

My choice for investigation:

_____

_____

_____

Now consider your environmental issue. Specify exactly what it is that you might want to find out about that issue (For the fast food litter example, you may wish to determine the volume of fast food litter within a two block radius of your school building). With your environmental issue in mind, use the spaces on the following page to list the exact information you will collect with your survey. It is a good idea to list that information in question form. (Example: What is the volume of fast food restaurant litter within a two block radius of this community's junior high school?). The questions which you list in these spaces are (or will become) your research questions. (III-5)

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

4. _____

_____

_____

5. _____

_____

_____

Your are now ready to help your instructor and your classmates choose a topic for the class to investigate by sharing your ideas. Your instructor may ask for suggestions which can be listed on the chalkboard and discussed. Listen carefully to the possibilities and try to evaluate each. Which seem to be the best possibilities for investigation over a short period of time?

After your class has decided on the local environmental issue which you will investigate, the process of writing the instrument and planning for data collection can begin. Your goal in this task must be to collect accurate and useful data - data that are worthy of your time and effort. To be really useful, all surveys, questionnaires, and opinionnaires must deal with several "what" and "where" conditions. For example, what specific information is to be collected? Where (geographic area) is it to be collected? Also, questionnaires and opinionnaires must deal with "who" factors. From which population will the data be collected? Thought and careful planning on these factors before your investigation begins will provide more useful data for you later!

The sequence of questions which follows will assist you and your classmates in dealing with the "what", "where", and/or "who" questions as your survey is being planned. You should respond to those which your instructor assigns and then share your work with the class in order to make the best possible plan. Your teacher will probably list suggestions for these questions on the chalkboard and help you in selecting the most promising choices. (III-6)

Making a Survey, Questionnaire, or Opinionnaire:

A Planning Sequence

1. What environmental issue or condition has the class chosen to investigate?

2. What are the research questions related to this issue which you want to have answered?

3. Exactly what information (data) will be collected by this instrument?

4. Is this to be a . . . ___survey . . . ___questionnaire . . . ___opinionnaire?

5. In what geographic area will the data collection take place?

6. If this is to be an opinionnaire, what are the exact beliefs and/or opinions being investigated?

7. If this is to be a questionnaire or opinionnaire . . .

A. What is the exact population from which the data are to be collected?

B. How large do you think the sample will need to be to represent the entire population?

C. How will you go about selecting your sample?

D. Which data collection technique will you use (e.g., telephone survey, mail survey, etc.)?

8. What are the exact procedures necessary to collect data with this survey? That is, who will collect the data? How will it be recorded? During what time periods will it be collected?

9. How can all the collected data be recorded and organized in a Data Summary Sheet? (Sample Summary Sheets were presented earlier in this module. You may need to design one for your survey.)

You and your classmates' best responses to the preceding questions make up the guidelines for what your survey will look like and how it should be used. Remember that at this point we are only concerned with getting information about an environmental issue. You will learn how to interpret your findings and how to communicate them to others in Module IV.

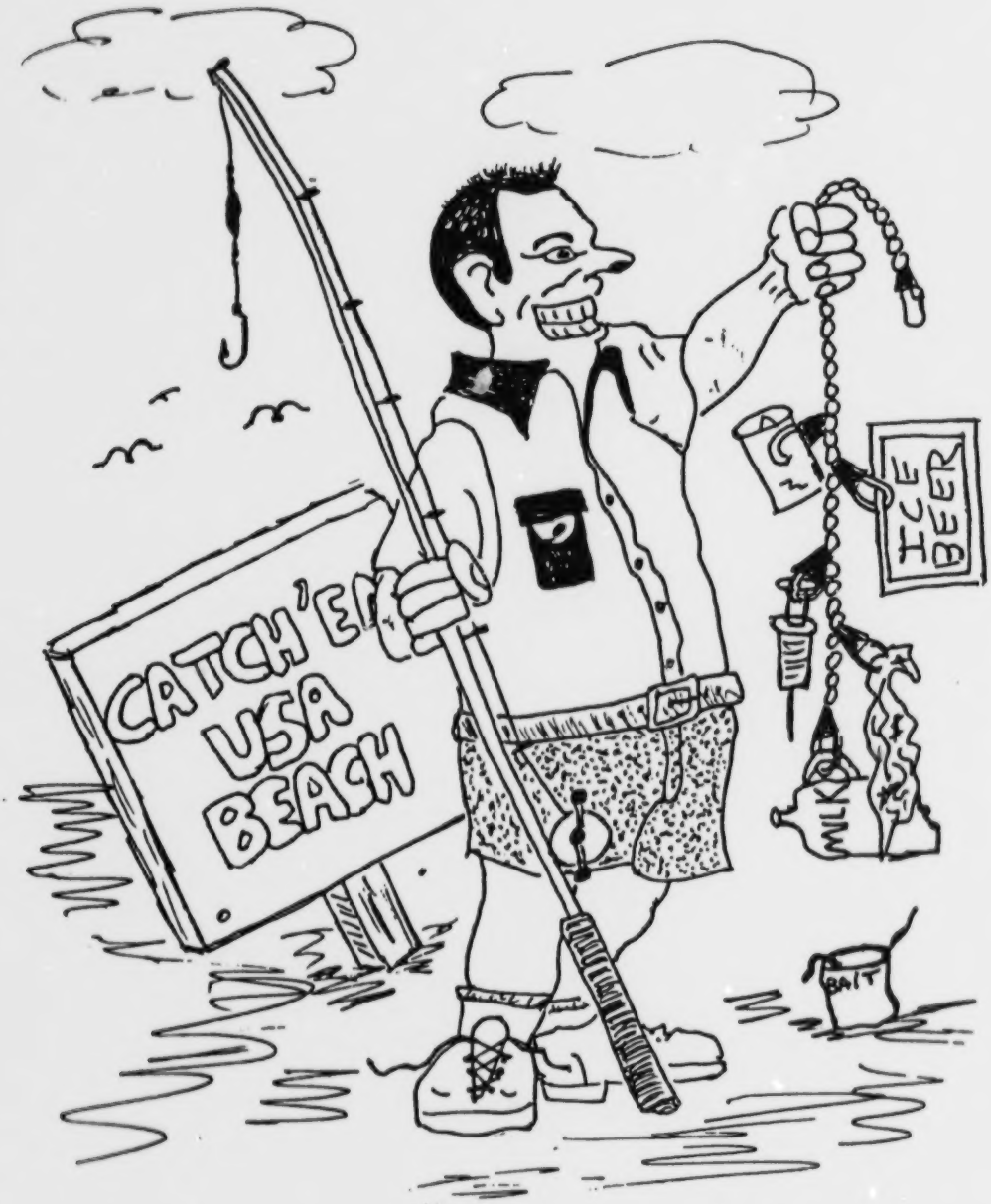
The next step is to prepare your survey using the guidelines you formulated in the previous activity. Again, the examples presented earlier in this module could serve as models. You may wish to have your teacher look over and edit your survey before you make a final copy. And it is always a good idea to try out the survey on several people. Just make sure that whoever you use in your trial run (pilot test) is a member of your population, but is not a member of the sample you will want to survey!

Finally, important details of actually collecting the data must be considered. Which students collect the data? Who collects the completed forms? Who computes totals, percentages, etc. How many students teams are needed for each task? What is the best timetable? Will you need to get permission to collect data in certain areas? These are all conditions which are specific to your class and to your school. . . and to the nature of your survey. Thus, they must be solved collectively by you and your classmates with the approval of your instructor.

After you've ironed out all the details and your survey has been completed, data summaries must be prepared. These data summaries will be used as you learn to interpret your findings in Module IV.

Now, let's take a quick look into the future. Module V of this book will ask you to investigate an environmental issue . . . on your own! The skills of designing surveys and of collecting data should come in handy for you as you tackle that task. We hope that this module has been very helpful to you in that regard.

Correct responses (III-4): 1. survey; 2. opinionnaire; 3. opinionnaire; 4. questionnaire; 5. survey; 6. survey; 7. questionnaire; 8. survey; 9. opinionnaire; 10. questionnaire.
How well did you do? If you got nine out of ten, your concepts are in pretty good shape!



"Can you imagine? Somebody told me that this beach was too polluted to catch anything! Just look at these!"

MODULE IV

INTERPRETING DATA FROM INVESTIGATIONS

Introduction

Science is sometimes called sensory reality. This means that only those things that can be observed with one or more of the senses are considered real to the scientist. The "sensory reality" definition of science does not cover all of what science is about. But, it does offer us some clues as to what we are able to do with information collected during research.

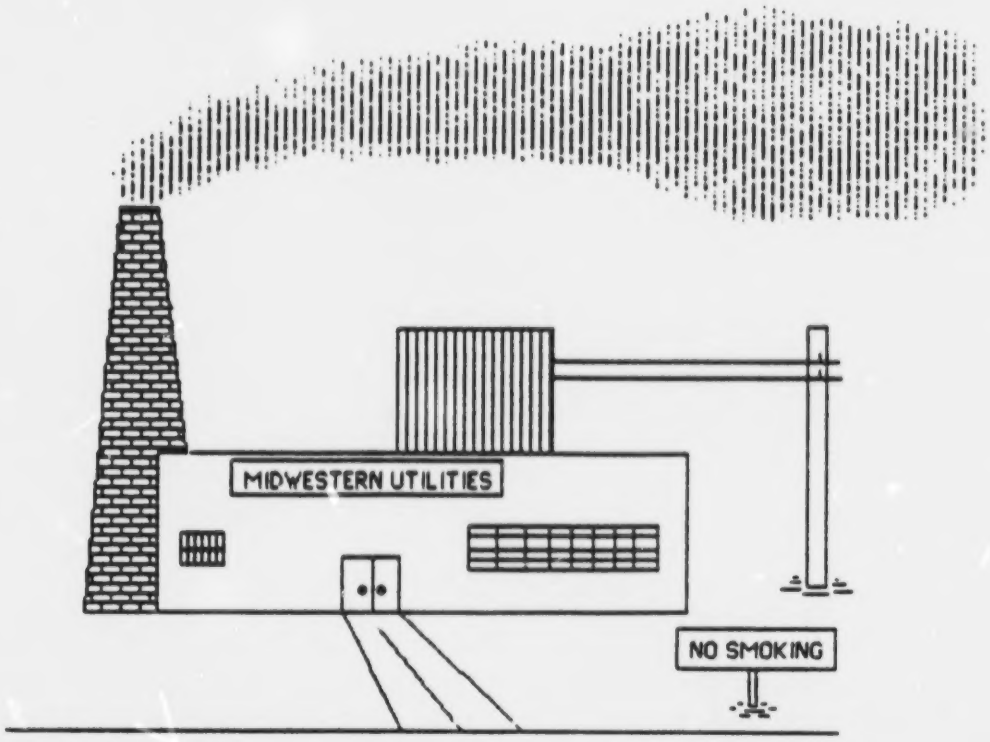
Information collected by the scientist must be interpreted. It won't just lie there interpreting itself. Interpretation is a human task and is no better than the skills of the person doing the interpreting. Therefore, if a person reads too much into the data he/she runs a serious risk of making incorrect statements as a result. It can be very embarrassing to have someone prove you wrong later. More importantly, reading too much into your data can also cause you to make some very poor decisions regarding your research question(s).

This module is designed to help you become familiar with a few of the basic types of data interpretation. It will not cover all aspects of interpretation nor will it cover all possible situations in which you might find yourself. However, if you learn to use the rules presented, you should be able to transfer these skills to new situations without too much trouble.

Objectives for Module IV

Upon completion of Module IV you will be expected to be able to . . .

1. . . . define conclusion, inference, and recommendation.
2. . . . distinguish between a conclusion and an inference (from a scientific perspective).
3. . . . evaluate conclusions based on observations.
4. . . . write conclusions and inferences for everyday-type observations.
5. . . . defend the idea that a person can make more than one inference for a particular observation (or set of data).
6. . . . write conclusions, inferences, and recommendations for imaginary scientific data.
7. . . . write conclusions, inferences, and recommendations for real scientific data.
8. . . . demonstrate the ability to graph scientific data.
9. . . . communicate the advantages that graphic data can have over descriptive data.
10. . . . revise a recommendation (if necessary) based on new information.



Conclusions

Everyone thinks they know what a conclusion is. It's the end or the finish to a speech, a story, or a meal. A good meal concludes with dessert, right? But, what about conclusions in science? What are they? How do we use them? How can we keep from making mistakes with them?

A conclusion in science is not too difficult to understand. Even so, it is easy to abuse or misuse conclusions. Lots of people do exactly that! A conclusion in science is an expression or a statement of the end result. It is the final result as shown by the data - the outcome.

Many people mess up conclusions when they use them to interpret the results of a study. That is, problems arise when they try to explain why something happened as it did. This is NOT a conclusion. It is something else which we will go into later.

Let's see if we can help you get the idea more fully. We'll call this Exercise IV-1 and begin it with an example:

> Some years ago, a scientist observed that kestrels (formerly called sparrow hawks) prey on and eat certain song birds such as the yellow warbler. She observed this on several field trips and at a variety of locations. (Of course, kestrels prey on and eat large numbers of mice and many insects as well.) The scientist wrote her findings and made the following two (2) conclusions:
>
> Conclusion No. 1: Kestrels and warblers have a predator-prey relationship in areas where both exist.
>
> Conclusion No. 2: It appears as though the kestrel may be a harmful factor in the reproductive capacity of yellow warbler populations.

Now, how do these conclusions strike you? Do they seem logical and fitting for the scientist's observations? Put your thoughts on paper . If the conclusion seems alright, check "yes". If not, check "no".

Conclusion No. 1: Yes _____ No _____.

Conclusion No. 2: Yes _____ No _____.

Conclusion No. 1 is excellent. It follows exactly the observations made by the scientist. Conclusion No. 2 probably resulted because the scientist felt that warbler populations were harmed by the kestrels. It is a terrible conclusion! Why? Because it is not a statement of the results of the scientist's observations. It is, instead, her personal interpretation of the results and *it goes beyond the observed data.* She might **infer** the statement about reproduction. She might even develop a research question to investigate whether this relationship exists, **but it is not a conclusion!**

We are not finished with the business about conclusions but, for a little while, we are moving to another term. This one is the inference.

Inferences

In the dictionary you will often find that **conclusions** and **inferences** are used similarly - that they are synonyms. Not true in science! Even though some people misuse these terms in science we are going to ask you to be correct in your use of them.

An inference is an implication - an assumption or a judgement made from data (or from conclusions).

Conclusion No. 2 in the exercise you just completed was an inference, although not a very good one. But, still, it was an inference because it was a judgement made by the scientist on the data she observed.

Some experts say that an inference is an explanation of an observation. That's a pretty good definition because it helps us remember that an observation is what we see (or gather from one of the other senses) and **an inference is the explanation of the observation.** A number of years ago, a famous scientist by the name of Alexander Fleming observed that certain bacteria grow poorly or not at all when in the presence of certain molds. He **inferred** that there was something about the mold that kept the bacteria from growing and reproducing. This **inference** resulted in the development of penicillin. Quite an important inference, wouldn't you say? Do you see the difference between Fleming's observation and his inference?

Conclusions and Inferences Made Easy

Suppose you and a friend walked to town one nice summer evening and decided to go to a movie after getting there. After two hours in the movie, you leave the theater and walk out onto a wet sidewalk. Further, the streets are wet and puddles of water stand here and there. From this situation you can . . . (IV-2)

Conclude?_____

_____

Infer?_____

_____

The next morning, you look out the window and see a moving van backed into your neighbor's yard. What can you . . .

Conclude? _____

_____

Infer? _____

_____

A little while later, you see what appears to be the driver of the moving van pouring something into the truck's fuel tank from a five gallon can. What can you . . .

Conclude? _____

_____

Infer? _____

_____

Let's see how well you have done. When you walked out of the movie theater there wasn't much you could **conclude** except that the streets and sidewalks were wet. But, you could infer that it had rained while you were watching the movie.

With the van backed into the neighbor's yard you could probably **conclude** that a moving van had backed into the yard sometime during the night or early morning. You possibly **infer** that the neighbors are moving.

The person at the fuel tank of the moving van might or might not be the driver, but you can **conclude** that someone is pouring something into the fuel tank of the truck. You might **infer** that the substance is diesel fuel.

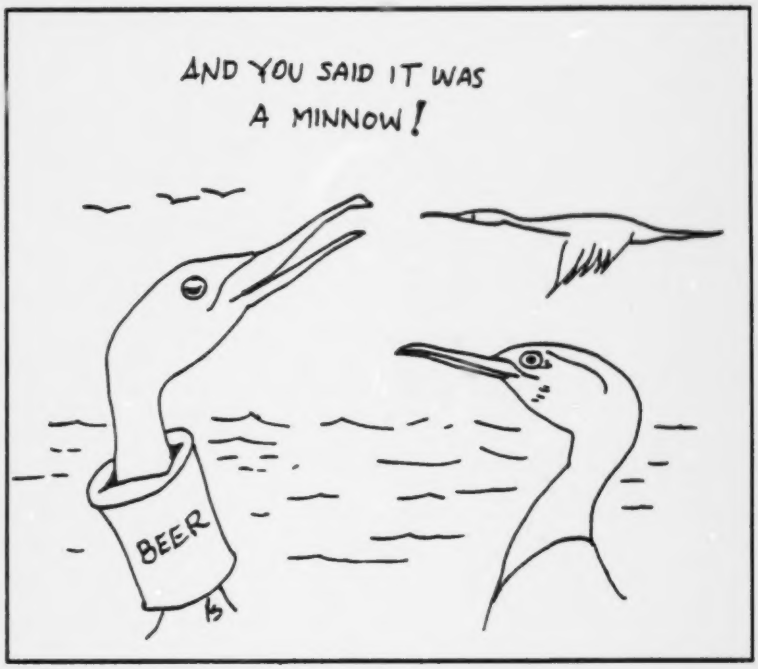
What one thing is clear about these inferences? Yes, they are explanations of observations you have made. Something else should be clear (but it might not be). This is simply that you have proved none of your inferences. You say this isn't important? Wait just a minute! A water truck sprayed the streets in the downtown area the night you went to the movie. The van's driver backed into the wrong yard. The driver was pouring gasoline into the fuel tank - that particular truck doesn't run on diesel fuel!

You think you were tricked? Perhaps! But we are trying to make a point here - that inferences are not proof until they have been tested somehow. How do you test an inference? In the case of your examples it would have been easy. You ask a police officer or someone else if it rained while you were in the movie. You ask the neighbors if they are moving. You ask the driver of the van what is being poured into the truck's fuel tank. In each case, whether the person talked to knows it or not, you are testing an inference. When an inference becomes something testable in science we call it a **hypothesis**. But, for now, let's go on to recommendations and leave hypothesizing out of the picture.

Let's Learn About Recommendations

Don't worry, we won't forget conclusions and inferences. We will return to these after awhile. But, we are going to take just a little of your time and deal with recommendations. What is a recommendation? How do we go about making good recommendations?

A recommendation is a piece of advice given to a person or a group concerning some particular action or problem. It is normally something you are in favor of - something you would advise being done. In science, however, a recommendation must be consistent with the findings of the study. In other words, you must never recommend something that cannot be defended in terms of the research. Even so, recommendations often reflect a person's values (even though they can be defended by the data).



Let's try an example. Suppose a student did a survey of litter in a certain neighborhood and observed large numbers of beer cans lying around. He infers that residents of the neighborhood or passers-by (or both) throw empty beer cans around the area. His recommendation is that the City Council pass a city ordinance forbidding the sale of beer in cans. Naturally, this is a ridiculous recommendation to make (based on this study). If the student wants to get the city to forbid the sale of beverages in metal cans, he had best find another reason for making that particular recommendation.

However, what kinds of recommendations **might** the student make during his research report? Write at least two logical recommendations below: (IV-3)

Recommendation No. 1:_____

_____

Recommendation No. 2:_____

_____

Even though you don't have a lot of information about this litter survey, there are several recommendations that might seem logical. The student might recommend stepping up anti-littering law enforcement in the area. Further, he might recommend an educational program in the city to demonstrate the ill effects of littering in the area. A recommendation that would produce at least temporary relief could result in a civic or school group cleaning up the neighborhood as a public service project.

It All Depends On How We Look At Things!

We have been talking about conclusions, inferences, and recommendations. Very soon, you will have a chance to apply what you have learned. But before you do, you need to look at one more part of data interpretation - how the data are communicated.

Data interpretation depends, many times, on how the data are reported. Let's look at some real information that is presented two different ways to see how this is true. Our topic will be the food resources for deer in eastern hardwood forests. The first method we will use to communicate the information to you is called descriptive. The second method is called graphic. See if you don't think that there is a good deal of difference between these two methods.

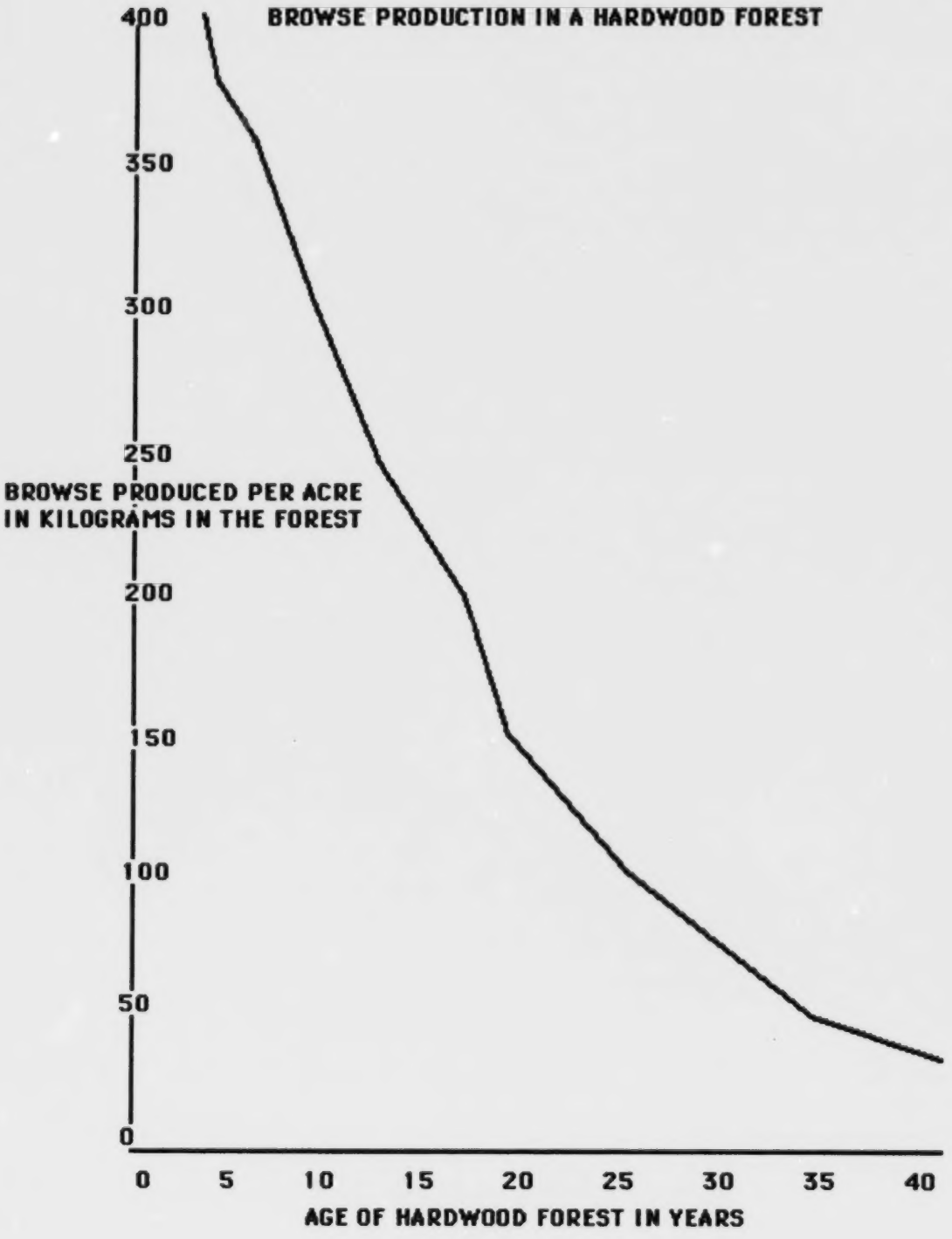
A Descriptive Account of Browse Production

The food available to deer in a hardwood forest is called browse. Browse consists of the buds, stems, leaves, and fruit of forest trees, shrubs, and herbs. Deer eat these plant parts as they graze through a forest at night or early in the morning. If this kind of browse isn't available to deer, they will often turn to the grain or fruit crops of farmers. For example, deer love apples and will even swallow them whole if they are small enough.

Wildlife experts know that the amount of browse available to deer is controlled by the height to which a deer can reach when feeding. Therefore, a very young forest will often have more available browse than an older, more mature one. A five year forest with small trees will produce about 400 Kg of browse per acre per year. At fifteen years of age, the production of browse is reduced to about 225 Kg per acre per year. At twenty-five years of age, browse production falls to only about 50 Kg per acre per year. The age of a forest, then, can have a lot to do with the size and general health of a deer population because of the browse which is available.

A Graphic Account of Browse Production

Please see the graph on the following page.


BROWSE PRODUCTION IN A HARDWOOD FOREST
400
350
300
250
200
150
100
50
0
BROWSE PRODUCED PER ACRE
IN KILOGRAMS IN THE FOREST
0
5
10
15
20
25
30
35
40
AGE OF HARDWOOD FOREST IN YEARS

(IV-4) You've just looked at two different methods for presenting data. Both of these techniques of reporting data communicate some of the same things. What conclusion can be drawn from both sets of data? State it here:

_____

_____

_____

Write an inference that can logically be drawn from both sets of data:

_____

_____

_____

Now, how do the two sets of data differ? Of course, there is a definition of browse in the descriptive data which does not appear in the graphic data. But, other than this and the fact that one is descriptive and the other graphic, how do they differ?

_____

_____

_____

All things considered, the graphic form of reporting is probably better than the descriptive. Why? The data show a relationship between the age of the forest and the amount of browse produced. The relationship is simply this: Younger hardwood forests produce more browse than older forests. But, **reading** that relationship is not nearly as effective as seeing the relationship described on a graph.

Further, the graph shows that the rate of decline in browse production is slowed somewhat after the forest reaches 25 years of age. This would permit the investigator to predict that the amount of browse in a 45 year old forest would not be a great deal less than in a 35 year old forest. Is there any way this could be predicted from the descriptive data? Probably not!

So, how you communicate data and how you interpret it depends upon the kind of information you have and what you want to do with it. **Always communicate data in the most logical way. And, remember that how well you can interpret data may depend on how you choose to communicate it.**

Producing a Line Graph (IV-5)

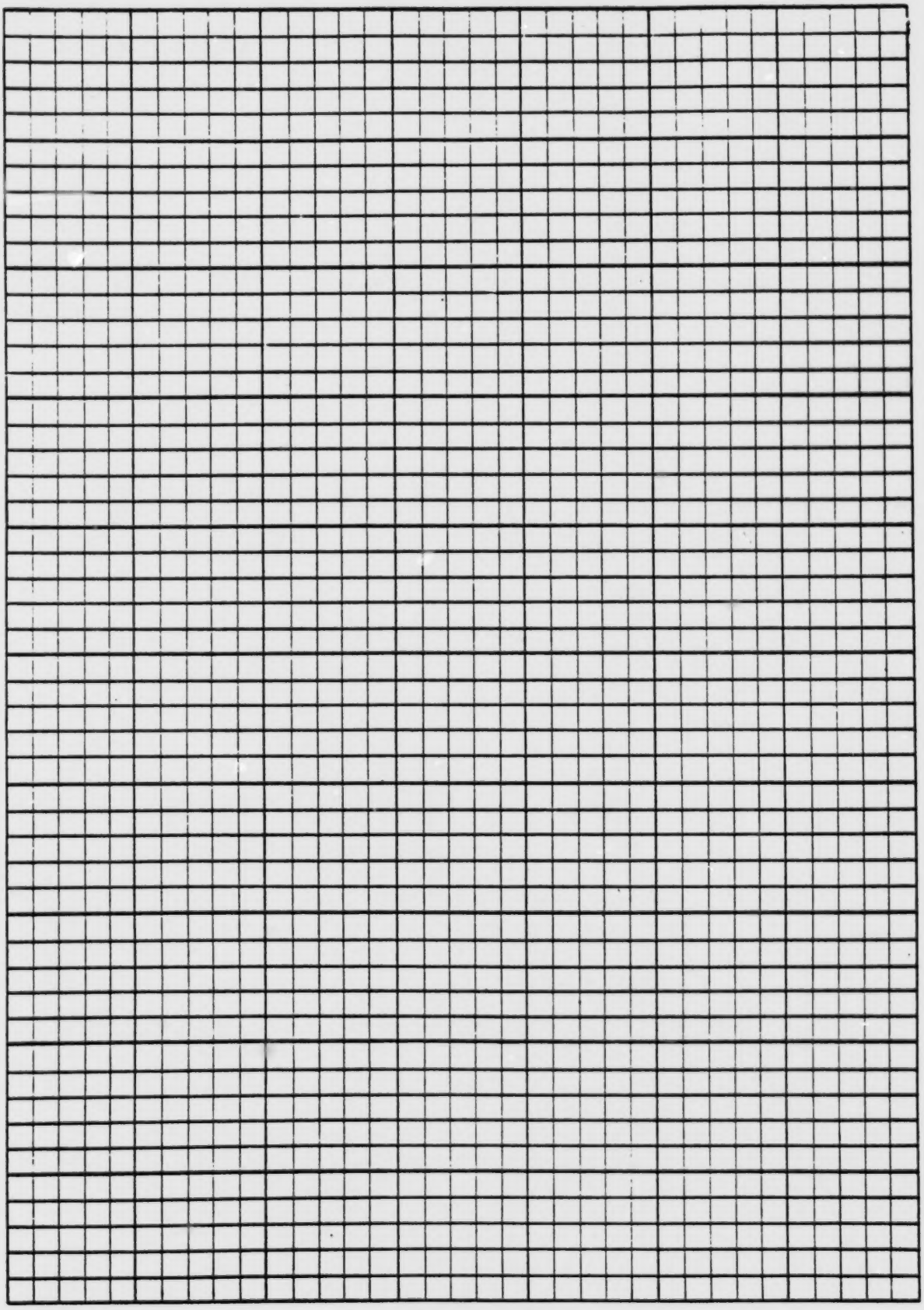
Do you think that you can report data in graphic form? Graphing is a skill just like any other process. We are going to ask you to graph some historical data collected over the years about deer population on the Kaibab Plateau in Arizona. You may be getting a bit tired of studying deer but these figures might surprise you - particularly after you see them on a line graph. Here are the data:

Deer Population Data on the Kaibab Plateau From 1907-1938

The Year	Population of Deer
1907	6,000
1910	10,000
1915	25,000
1920	56,000
1923	100,000
1925	85,000
1930	30,000
1935	14,000
1938	9,000

Please graph these data using the graph worksheet provided on the next page. The population variable should go on the vertical axis of the graph. The year variable goes on the horizontal axis. Label both axes.

Your instructor will want to check your work on the graph. Also, he/she may ask you to do some additional tasks connected with reporting data. If so, hang in there and get the job done well! You are almost ready to be an independent investigator of environmental issues.



Applying Your Data Interpretation Skills (IV-6)

Using the Kaibab Plateau deer population data given by the graph, write out the best possible conclusion that can be drawn from the data.

_____

_____

_____

Now, we will tell you that, between 1907 and 1923, 300 coyotes and 600 mountain lions were killed on the Kaibab Plateau. For the years between 1907 and 1923, write the best possible **inference** you can from all the data at your disposal:

_____

_____

_____

Lastly, we tell you that, during the years of increasing and decreasing deer populations, the range of the deer was so badly overgrazed that thousands of deer died from starvation. What logical **recommendation(s)** would you make based on all available information?

_____

_____

_____

Another Try at Data Interpretation

You are probably getting better and better at data interpretation. That is good! These skills are very important, especially if you intend to make decisions based on your research findings. Let's look at another set of data, one having to do with coyotes.

Western ranchers have been at war with the coyote for some time. Sheep ranchers, in particular, have said that the coyotes cause economic losses by killing many of their animals. For years, the government has helped farmers and ranchers control coyote populations. Traps, poisons and even hunting by airplane have been used to reduce the number of coyotes.

Let's suppose you wanted to make an informed decision about whether the government-sponsored coyote control programs should be continued. Your research question might look like this: **Research Question: To what extent should a government sponsored coyote control program be continued in the western states?**

Below, you will find some data collected in Kansas by scientists who analyzed the stomach contents of 1600 coyotes killed by hunters during one year. These data will be helpful to you in answering your research question. As you study the data table and the additional information it will be important to keep the research question in mind.

An Analysis of the Stomach Contents of 1600 Coyotes

Percentage of Diet

	Rabbit	Carrion	Chicken	Rodent	Other
Spring	45.7	26.0	11.5	11.8	5.0
Summer	47.7	19.3	15.3	10.0	7.7
Fall	47.3	23.0	10.3	10.7	8.7
Winter	52.7	27.7	8.3	8.0	3.3

(*Adapted from You and the Environment - An Investigative Approach, 1976.*)

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As the scientists examined the contents of the coyote stomaches, they placed food types into several categories. "Rabbit", of course, included the percentage of rabbits which were found. "Chicken" included any poultry or wild birds. "Other" included fruits, grains, insects, and snakes. "Carrion" included decaying flesh, whether it came from wild animals or livestock. Coyotes often find carrion on the range. The scientists noted that most of the livestock flesh found in coyote stomaches was decaying before the coyotes ate it. Fresh livestock appeared to make up a very small portion of the coyote's diet.

Now, let's repeat the **Research Question: To what extent should a government-sponsored coyote control program be continued in the western states?** In order to answer this question, you will need to produce a conclusion regarding the coyote's diet. Please write a conclusion which summarizes those food types which coyotes eat frequently, those that are eaten some of the time, and those that are rarely eaten. What is your **conclusion** drawn from the data? (IV-7) **Conclusion:**

Next, write an **inference** based on your conclusion. In fact, several inferences are possible, depending on what outcomes were cited in the conclusion. To write the most appropriate inference, keep in mind the focus of the research question. Remember, an inference is an explanation or judgement based on the data. **Inference:**

Finally, write a **recommendation** which is consistent with the findings. That is, what advice would you offer concerning the continuation of government sponsored coyote control programs? **Recommendation:**

Perhaps additional information could assist in writing a more specific recommendation. One method of coyote control is the use of a long-lived poison, "1080". The poison 1080 is usually placed on carrion. Unfortunately, this poison becomes available to many other wild and domestic animals besides coyotes. Ferrets, eagles, dogs and other animals are killed by 1080. Many sheep ranchers support the use of 1080 in government-sponsored coyote population control programs. Many conservationists are violently opposed to its use. With this information in mind, write another **recommendation** about the use of 1080 which is consistent with the data.

Recommendation: (IV-8)

_____

_____

_____

_____

A few other thoughts about the coyote are necessary. Our original Research Question asked about the extent to which government-sponsored coyote control programs should be continued. Do the data, as they are presented in this module, directly answer that question? Please explain your answer. (IV-9) Yes _____ No _____. Explain: _____

_____

_____

_____

_____

It is also important to remember that the data presented deal only with Kansas coyotes. To what extent do you think your conclusions, inferences, and recommendations are valid for other western states? Please answer and defend your decision. (IV-10)

_____

_____

_____

_____

Data Interpretation With Surveys (IV-11)

We've asked you to practice your interpretation skills using data collected by scientists. Now, let's look at data similar to those which you might collect. Let's pretend that the opinionnaire "Opinions About Littering" (see Module III) was used by your class. Further, let's pretend that two samples - adults and junior high students - were obtained. On the following page you will see the results which were obtained on Question 1 using that opinion survey (these are imaginary data only).

Question No. 1: Do you consider littering of public and/or private property to be a problem in this community?

Yes _____ No _____ Undecided _____.

Data Summary: Question No. 1

Sample: Junior High School Students (47)

	Males	Females	Total
Yes	5	4	9
No	17	20	37
Undecided	0	1	1

Sample: Adults (52)

Yes	15	19	34
No	10	8	18
Undecided	0	0	0

Carefully study the data summaries of both samples. Look at how the junior high sample answered the question. Now note how the adults answered the same question. Did both groups answer the question in the same way? Now, write a conclusion for Question No. 1. Remember, a conclusion is a summary of what happened. **Conclusion:**

_____

_____

_____

_____

_____

Your conclusion should have noted that more adults than junior high students believed that littering was a community problem. If your conclusion did not focus on this, carefully re-examine the data.

Your next task is to **infer** why this difference might have been observed. In other words, why did adults answer the way they did, compared to the way junior high school students did? (Why might there be more than one inference here?) **Inference:**

_____

_____

_____

_____

_____

_____

The final task is to write a **recommendation.** Think about the difference which you observed between adults' littering beliefs and those of junior high students. Based on the inference you write, what recommendation might you make? (If you feel that it is impossible to make a recommendation based on your inference, please comment on this in the space provided and explain why.) **Recommendation:**

_____

_____

_____

_____

With this practice, the process of data interpretation should be clearer. However, a bit more practice will probably prove useful. Therefore, let's examine more imaginary data from our opinionnaire.

Question No. 5: What age person do you believe is most responsible for the littering?

A. Students below junior high age.
B. Students of junior-senior high age.
C. College age citizens.
D. Citizens over the age of 21.

Data Summary: Question No. 5

Sample: Junior high school students (47)

	males	females	total
Response A:	5	5	10
Response B:	7	6	13
Response C:	6	6	12
Response D:	6	6	12

Sample: Adults (52)

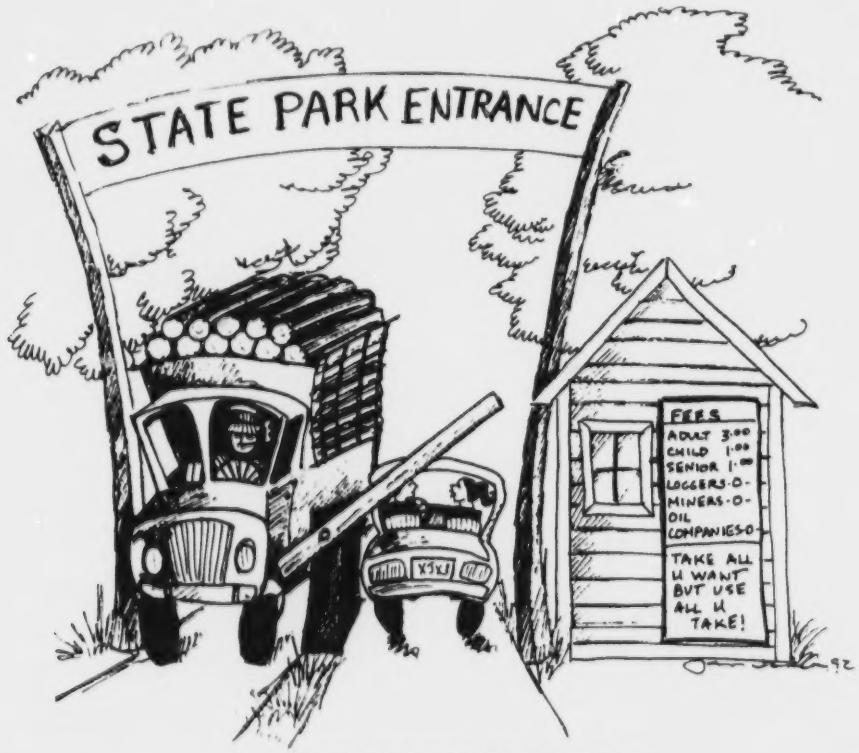
	males	females	total
Response A:	0	1	1
Response B:	18	20	38
Response C:	6	5	11
Response D:	1	1	2

Use the data summaries above to make conclusions, inferences, and recommendations for Question No. 5. Remember the differences between **conclusions, inferences, and recommendations**. Most importantly, everything you write must be consistent with the data.

Conclusion:

Inference:

Recommendation:



"IT'S GREAT TO SEE THE GOVERNMENT IS TRYING TO MAKE THE PARKS ACCESSIBLE TO EVERYONE!"

MODULE V

INVESTIGATING AN ENVIRONMENTAL ISSUE

It's Your Turn

The time has arrived! It's time for you to investigate an environmental issue of your choice. You will remember that many weeks ago, we told you that you were going to get to choose a specific issue and study it yourself. You should be able to do this now. You have a set of skills that you can apply to a problem of your choosing.

Now you have the opportunity to pick a particular issue and look into it to the extent that you will become an **expert** on that issue. In what are you interested? Is it issues connected with the population explosion? With water pollution? Pesticides? Toxic wastes? Energy production? Land use management? An endangered species? Sewage disposal? Wild Rivers? Game bird management? Wilderness preservation? Littering? Solid waste disposal? Abandoned autos? Zoning? Urban sprawl? Noise pollution? Soil erosion? Just **what** is it that looks important (and interesting) to study?

Remember, whatever it is you choose to study, focus on something that you can be successful with. Choose the right strategy for investigating the issue. And **don't** - whatever you do - **don't try to investigate all** endangered species or all of the issues connected with water pollution. That's an almost impossible task. Choose your area of study and define your problem carefully!

Your Assignment: An Issue Investigation

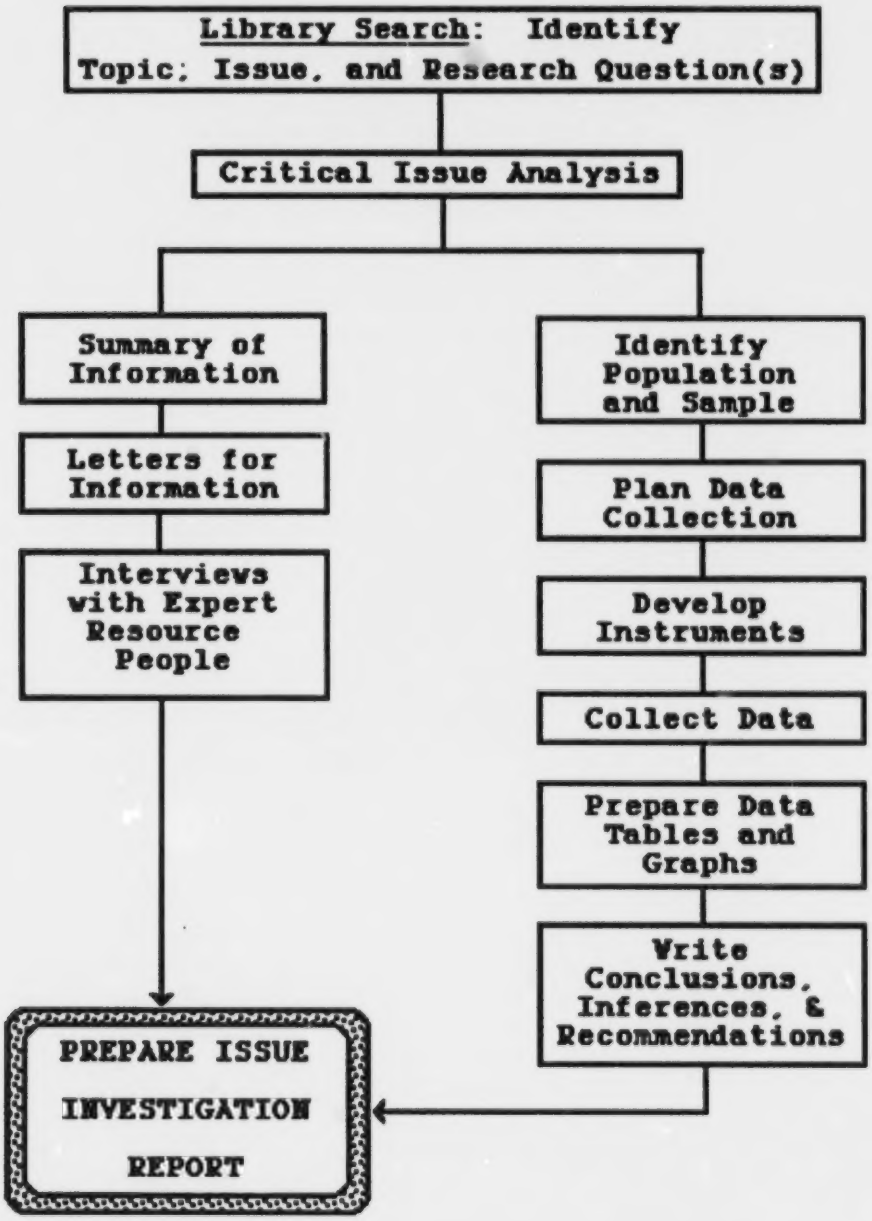
Your assignment is to conduct an issue investigation. This is a project made up of a number of complex tasks. The authors believe that your teacher can make the best decisions about how you should conduct your investigation. The discussion that follows **suggests** a model for investigating issues which has been used by many students. Remember, your teacher has the final say. Typically, the following steps are taken in many issue investigation projects:

A Model for an Issue Investigation

Step 1. Select an overall topic in which you are interested.
Step 2. Conduct your library search on the topic of interest to you.
Step 3. Identify an important environmental issue related to this topic.
Step 4. Critically analyze this issue, identifying important players as well as their positions, beliefs and values.
Step 5. Write research questions about the issue.
Step 6. Summarize the secondary information you have collected.
Step 7. Write letters for information and interview resource people (as needed).
Step 8. Plan a data collection strategy designed to collect data which could answer the research questions.
Step 9. Develop, pilot, and revise a data collection instrument (for investigations using primary sources of data).
Step 10. Collect the data.
Step 11. Organize the data into tables, charts, and graphs.
Step 12. Interpret the findings making conclusions, inferences, and recommendations.
Step 13. Produce a final written issue investigation report.
Step 14. Present your investigation to the class.

The diagram on the following page presents these steps and provides a visual way for you to understand the nature of the task at hand. But remember, the final decision concerning the investigation rests with your teacher. So the steps you follow might differ from those presented here.

SUGGESTED ISSUE INVESTIGATION PROCEDURE:
A FLOWCHART



Decisions must be made about your issue investigation. Your teacher will communicate this information to you. Please **record** the exact criteria specified by your teacher for each of the headings below. (V-1)

1. **How will you organize to investigate an issue** - individually, in pairs, in small groups, etc.?

_____

_____

2. **What kind of data should be collected** - primary, secondary (print material, interviews, letters for information), or some combination of the above? Further, how many of each kind should be used?

_____

_____

3. **What are the components of the final product?** Typically, the report is divided into a number of sections: (1) a **purpose** section which contains the research questions and explains the importance of the issue investigated, (2) a **plan** section which details the data collection including population, sampling method, and instrumentation, etc. (3) a **literature** section which reviews information collected via letters, interviews, and secondary sources, (4) a **results** section which contains graphs, data tables, and an issue analysis (an analysis of positions, beliefs, and values), (5) a **findings** section including conclusions, inferences,and recommendations, and (6) a **bibliography**. An issue action plan might be added after you have completed Module 6.

List any additional criteria supplied by your teacher for your written issue investigation report.

_____

_____

_____

_____

_____

_____

_____

_____

_____

4. What is the due date for the final product? Are there due dates for various sections of the report? If so, what are they?

5. In what style should the final report be produced . . . typewritten or by hand? What about margins? Title page? Titles for sections and subsections? Bibliography form? Etc. Etc.

6. Are there any other special directions and procedures for seeking teacher help, using the library, obtaining school stationery, using the phone, photocopying, etc.?

You now know what your teacher expects of you. Yes, it is a big job! But many other students achieved admirable results doing the same task. It is now time to start making real decisions concerning your issue investigation.

Hopefully, you have a good plan for collecting quality data Still, some students have trouble meeting deadlines for big projects. One way to help use time wisely is to divide the investigation project into smaller sections. That is the purpose of the checklist that follows. Your teacher might or might not decide to use it with you. Regardless, a checklist of investigation tasks is certainly a helpful way of helping fit your investigation into a workable timetable.

Investigation Task Checklist

(V-2)

Investigation Task	Due Date	Teacher's Approval
1. Selection of issue topic	_____	_____
2. Completion of secondary source search	_____	_____
3. Approval of research questions	_____	_____
4. Approval of letters for information	_____	_____
5. Approval of interview questions/format	_____	_____
6. Approval of data collection plan	_____	_____
7. Approval of instrument	_____	_____
8. Approval of data collection	_____	_____
9. Approval of charts, tables, graphs	_____	_____
10. Approval of conclusions, inferences, and recommendations	_____	_____
11. Approval of final report	_____	_____
12. _____	_____	_____

The checklist above should help you be more effective working independently on your project. There is one more thing that might help you understand the nature of independent work - a contract. The **contract** on the next page is an opportunity for you and your teacher to agree on the responsibilities and rewards of effective, independent work.

ISSUE INVESTIGATION CONTRACT

Student: _____ Teacher: _____

Name of Issue Investigation:

_____

_____

I hereby contract with my instructor that I shall use all my mental ability and those skills in which I have been trained in order to successfully investigate the issue chosen. Further, I guarantee that my independent investigation will be conducted in a manner so as to give me pride in myself and to respect the rights of other human beings.

I understand that my research will be evaluated on a raw-score basis and that my final grade for this project will be based on the number of points earned. Further, I have read the following breakdown of criteria and understand how I will be evaluated.

Criteria	Possible Points	Earned Points
Quality of the research question(s)	_____	_____
Techniques used in the investigation	_____	_____
Seriousness of approach to research	_____	_____
Quality of data collected	_____	_____
Accuracy of conclusions	_____	_____
Quality of inferences	_____	_____
Accuracy and organization of final report	_____	_____
Class presentation	_____	_____
Other _____	_____	_____
Grand Total	_____	_____

_____ _____

Signature of Student Signature of Teacher

_____ _____

Witness Date

Perhaps an example of one student's issue investigation would be helpful. The following outline sketches the high points of Jill B's project. Maybe it will give you some ideas.

Jill B's Issue Investigation: Illegal Dumping in Randolph County

Research Questions:

How many illegal dump sites exist in Randolph County?
Where do illegal dump sites exist in Randolph County?
What kind of materials do they contain?
What are county road commissioners' beliefs about the effects of, causes of, and solutions to illegal dumping?

Data Collection Strategy:

A questionnaire and county plat book were mailed to county road commissioners. (County road commissioners are elected citizens responsible for the monitoring and maintenance of rural county roads.) They were asked to mark illegal dump sites within their townships on the county plat. They were also asked to respond to the opinionnaire.

Letters were sent to county officials in Randolph County to determine the solid waste disposal practices in the county. A letter was also sent to the Randolph County State's Attorney to determine state laws about solid waste disposal.

A review of secondary source information was conducted.

Results:

Dump site locations were plotted on a county map. Visits were made to dump sites to photograph and classify the dumped material. The data collected about the beliefs of the road commissioners were tabulated and graphed.

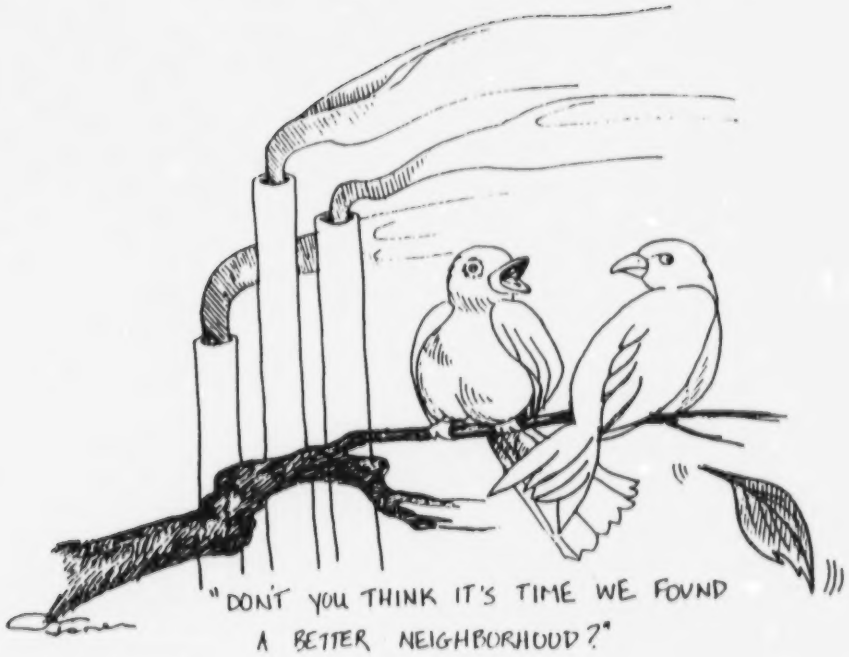
Final Report:

A written report was prepared which contained a purpose, plan, literature review, results, findings, and bibliography sections. This report was modified, supplemented by visual aids, and presented to Jill's class. The investigation was later adapted and used as a science fair project.

Action Plan:

Later, as a result of work in Module VI, an **issue action plan** was added to the investigation report. The action plan proposed how the issue could be solved. This involved a three level attack which included (1) the presentation of the report's findings to the County Board of Commissioners, (2) a publicity campaign in county newspapers, and (3) the organization of a student action group. The action group was to lobby the county government to adopt a system of strategically placed dumpsters on rural roads throughout the county.

It goes without saying that Jill B is well on her way to becoming an effective environmental citizen!



MODULE VI

ENVIRONMENTAL ACTION STRATEGIES

Introduction

Many students and adults are unhappy about a variety of environmental problems. But, they don't know how to go about helping to resolve these problems. Environmental action is the key to these solutions. Only when citizens have the skills needed to take action will solutions be found for many issues. In Module VI you will have an opportunity to learn how to use most of the strategies involved in environmental action.

Many students have become involved in helping to solve environmental issues as individuals and as members of organizations. Recycling campaigns, petition drives, wildlife adoptions, persuasive letters, and many other strategies have been used by these young people. The skills needed to develop and implement these kinds of actions will be identified and practiced in this module.

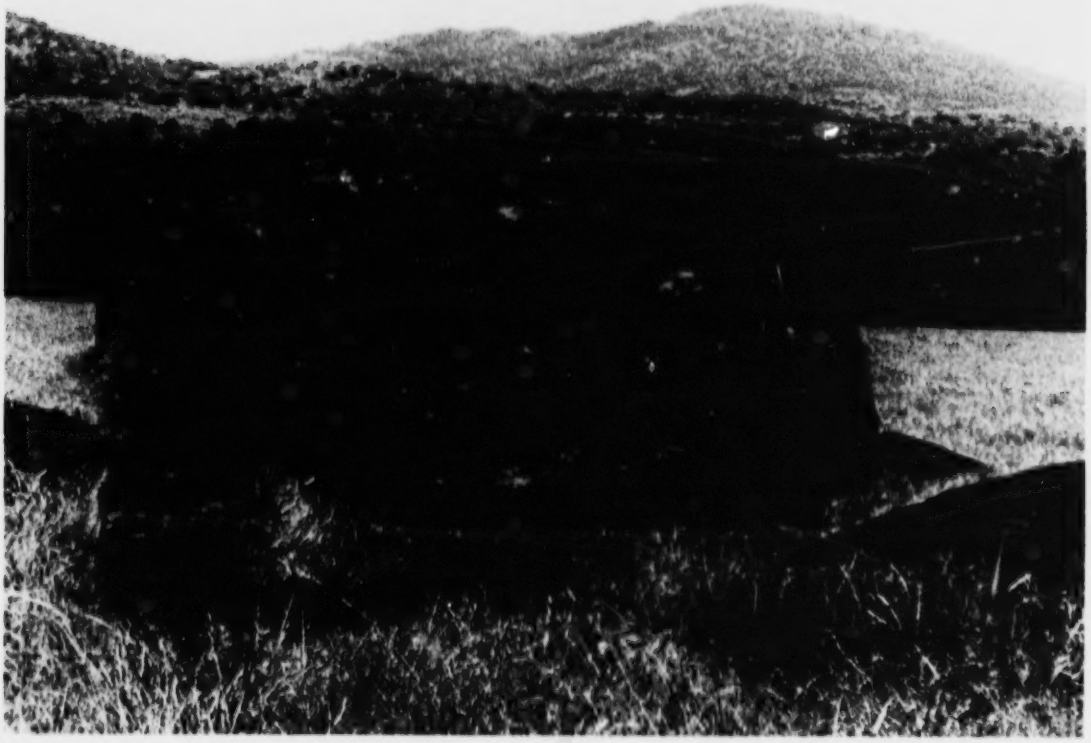
If you were successful with Modules I through V, you are certainly an expert in investigating environmental issues. Probably, by now, there are issues in which you are interested. As a citizen, you would like to help solve these issues. The skills presented in Module VI will help you do exactly that.

Objectives for Module VI

Upon completion of your work in Module VI you will be expected to be able to...

1. ...identify at least two reasons why it is difficult to classify a particular environmental action as positive, negative, or passive.
2. ...propose one example of an environmental action which could be classified as either positive or negative and defend both of these classifications.
3. ...define the action method of persuasion and identify at least two examples of strategies which could be used in this category.
4. ...define the action method of political action and identify at least two examples of strategies which could be used in this category.
5. ...define the action method of consumerism and identify at least two examples of strategies which could be used in this category.
6. ...define the action method of ecomanagement and identify at least two examples of strategies which could be used in this category.
7. ...identify two advantages that group action has over individual action.
8. ...given any of fourteen action analysis criteria, explain why an individual should consider these before taking any type of environmental action.
9. ...given a specific example of an environmental action, apply the fourteen action analysis criteria listed in Module VI.
10. ...identify a given persuasive action as an emotional appeal, logical appeal, coercion, or combination of these.
11. ...produce an example of an effective persuasive action on some issue which combines both logical and emotional reasons for taking action and follows the appropriate guidelines for persuasive action.
12. ...describe the dangers of persuasive actions based only on emotion and give one example of an actual environmental issue in which such actions were taken.
13. ...identify three different kinds (modes) of persuasion and explain how each can best be put to use.
14. ...identify three categories of consumer action and describe issues for which each category of action is appropriate.
15. ...describe three kinds of political action and discuss how each of them may be effectively applied to environmental issues.
16. ...identify three situations in your area which could require ecomanagement type actions.

17. ...apply all necessary action skills and knowledge in developing a plan for action concerning some environmental issue. This would include identifying and summarizing the issue, identifying and evaluating possible actions, and making a final recommendation concerning action on the issue.



What Is Action?

In a quiet, southern Illinois town, a man drives his car across a railroad track and throws a beer can away . . . in Utah, a rancher hires a helicopter and shoots eagles out of the air . . . in Louisiana, a well-known official is discovered buying alligator hides from poachers . . . at a Midwestern park, college students entertain themselves by throwing glass bottles against a canyon wall . . . on a back road in Kentucky, a man pulls his pickup truck over to the ditch and calmly pushes an old washing machine into the weeds . . . on the east coast, a chemical company lies to the public about the environmental effects of its waste water . . . in Brazil, wild cats are killed, skinned, and the furs smuggled into the United States to be made into coats.

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These are a few actual accounts of environmental action. They all appear to have one thing in common. What seems to be common to all the examples of environmental action? Please respond below: (VI-1)

What are the common elements?_____

_____

_____

It would appear as though many kinds of environmental actions are negative - or, not in the best interests of the environment. You say that this is a value judgement on the part of the writers? Indeed, it is!

There are probably three different kinds of environmental action. These can be classified as follows:

1. **Positive Action:** This would be an action that helps improve or maintain the quality of the environment.

2. **Negative Action:** This would be an action that somehow decreases the quality of the environment.

3. **Passive Action:** This could just as well be called "no action" because it neither supports or hurts the environment.

Every day each citizen takes one or more of these kinds of environmental actions. It's not always easy to decide what the results of an action might be, so sometimes it is hard to classify a particular action. Why? Because people often disagree about their personal rights and about the effect of a particular action on the environment.

As you already know, environmental problems are produced because people have conflicting beliefs and values. On one hand, a man throws his beer can on the side of the road - on the other hand, another person believes that this violates his right to have a clean environment. On one hand, an oil corporation president decides that producing less heating oil will force prices up and increase his company's profits - on the other hand, a congressman believes that to protect consumers there should be a law against such practices. On one hand, there are countries in the world still sending whaling fleets to sea - on the other hand, many nations believe that whaling is not necessary and that the great whales should be protected. On and on . . .

Conflicting beliefs and values are almost always involved in environmental issues. Some individuals, for example, will use economic values to make a particular decision while other individuals will use primarily ecological, aesthetic, or some other value in approaching the same

decision. Because of this, the writers take the position that an environmental action must be weighed in terms of its total effect on the environment. This is not always easy. Perhaps a short exercise will help demonstrate this.

Classifying Actions. As noted earlier, there are three kinds of actions: **positive, negative, and passive.** Using the symbols (+) for positive, (-) for negative, and (0) for passive, code each of the following environmental actions in terms of how you would classify them. When finished, see if your classification agrees with those prepared by others in the class. If there is some disagreement, why might it exist? (VI - 2)

SYMBOL		THE ACTION
_____	1.	A college student goes home for semester break and leaves her pet dog to roam the community.
_____	2.	A movie star buys a leopard coat costing thousands of dollars.
_____	3.	A rural land owner realizes that his old car can't be repaired and pulls it into the weeds behind the barn.
_____	4.	A housewife buys soda (pop) in nonreturnable containers.
_____	5.	An apartment renter throws garbage away in a rusted-through garbage can in the alley.
_____	6.	A fisherman buys beer in aluminum cans. The cans will be tossed into the lake when empty.
_____	7.	A neighborhood gardener makes a compost pile out of grass clippings, fallen leaves, and organic garbage. Sometimes it smells.
_____	8.	In order to get better gas mileage, the neighborhood mechanic bypasses the pollution-control device on his car.
_____	9.	Instead of letting the faucet run to get cold water, a elderly lady keeps a jar of water in her refrigerator for drinking purposes.
_____	10.	A young couple decides that they want a large family because they love children.

Some of the above are tough to classify when the rights of the citizen are weighed against the good of the environment. Yet, these are the kinds of questions that have to be answered by every citizen each and every day.

Just because it is sometimes difficult to classify environmental actions, this does not mean that one should not attempt to do so. It does mean, however, that you should begin thinking in terms of the consequences of action! On the next page you will find one example of one individual's idea of a positive environmental action.

At this point we would like for you to read an actual account of one citizen's action-taking. While you read "One Citizen's Action: Negative or Positive?", think about the consequences of this action and decide how you feel about it. (VI-3)

One Citizen's Action: Negative or Positive?

The following is excerpted from: "Respecting the Law" by Peter Steinhart, Audubon, November 1987, pp 10-13.

[In late 1986, the] Louisiana-Pacific Corporation bought 98,000 acres of Mendocino County [California] timberlands from Masonite Corporation.

. . . Louisiana-Pacific already possessed 200,000 acres of timberlands in the county, and it already had a reputation for controversy. . . .

There were large demonstrations in front of the company's offices in Ukiah when LP began aerial spraying of herbicides without warning residents and even dropped herbicides on one of their own logging crews. "They have a reputation here as a real rape-and-run outfit," says Bruce Anderson, publisher of the Anderson Valley Advertiser in Booneville. "They don't negotiate anything. They don't discuss anything." . . .

Already LP was cutting vastly more than it had cut in the previous years. The industry averaged forty-acre cuts in the county three years ago, says Lucas [a former member of an advisory panel to the California Department of Forestry]. "Now it is common to have a one-hundred-twenty-acre clearcut." LP profits were up 150 percent in 1986, and up over 1,000 percent in the first quarter of 1987. The mill at Cloverdale was running sixteen hours a day to cut all this timber. And virgin redwoods were vanishing. . . .

In February [1987] Louisiana-Pacific started to harvest timber on Cameron Road, overlooking the Navarro River. The forest there had been cut fifty years before and had grown back lush and thick. But fifty years ago loggers didn't use D-8 Cats and Kubota tractors. In 1987 they did. And in 1987 a neighbor looked over the bulldozed earth, the piles of unburned slash and dying saplings, the bare soil running down gullies toward the Navarro, and said, "This is brutal logging." LP logged right up to the road. It took trees less than a foot in diameter. Slash piles were bulldozed back from the road to satisfy fire prevention rules. By July many of the tiny trees left behind as sun-shade and seed trees were dying from sunscald. All around were trenches and heaved earth where Caterpillars had dragged out logs. It will be fifty years or more before residents see the forest recover. Declared an angry neighbor, "These people make desert." . . .

Late in February someone drove eleven-inch bridge nails into logs lying on the ground waiting for haul trucks to take them to the mill. On May 8th one of those logs was fed to the saw at Louisiana-Pacific's Cloverdale mill. It crawled along a conveyor belt and was seized by the clamps on the carriage, a locomotive-sized engine that grasps the log and hurtles it at high speed into the teeth of a fifty-two-foot band saw. As the saw sliced into the log, there was a loud whine of metal biting into metal. A twelve-foot section of the saw ripped away and snaked wildly up into the air. It caught twenty-three-year-old George Alexander, who was standing in front of the blade bearing off the cut boards, slashing through his jaw and both jugular veins. Had not a co-worker held the veins together, Alexander would have bled to death there on the floor.

What do you think about the tree spiking citizen action?
Was it positive? _____; Negative? _____.

What beliefs are you using to evaluate the tree spiking action? What values?

_____

_____

_____

How do you think responsible citizen activist groups felt about the tree spiking incident?

_____

_____

_____

How do you think public officials regard this kind of citizen action?

_____

_____

_____

This article also went on to state that tree spiking is not an uncommon occurrence in California. In fact, there has been a law against spiking since 1876. With the recent acceleration of redwood harvests, however, there has been a new round of spiking. With regard to the Cloverdale mill incident, responsible citizen action groups criticized it. The president of the timber company deplored it as "terrorism in the name of radical environmental goals." A month after the incident, a bill which increased penalties for tree spiking was introduced in the California Senate.

In a separate incident, moderate citizen activist groups were engaged in talks with a major timber company concerning how certain timber resources would be harvested. Some of their own trees were found spiked and the timber company cut off the negotiations in anger.

Think again about your own evaluation of this incident. Does your evaluation remain the same?

You and Action: Important Ideas

This module is designed to help you learn about and develop skills for taking environmental action. The writers know of students who have

recycled aluminum on a school-wide basis,
published environmental issue reports in the regional newspaper,
persuaded city officials to start a recycling center, and
formed a five school coalition designed to lobby state legislators to vote for specific environmental legislation.

These are examples of actual actions taken by groups of young people. But there are many actions you can take as an individual which will contribute to the quality of the environment. The authors believe it is important for you to learn about environmental actions now, so that you can begin to make a difference immediately, as well as be better prepared to make environmental decisions in the future.

The following are some principles of environmental action that we would like you to consider.

1. You have the right to be heard and to act on environmental issues.

2. You have the responsibility to exercise that right and to be knowledgeable and skilled in such actions.

3. Some actions are mandated by law (e.g., laws against littering), but most involve your own choice.

4. You have the ability to investigate environmental issues and to obtain enough information on which to base a plan of action.

5. Most of the actions you take in your life have some environmental consequence. You have the responsibility to consider whether an action will be positive or negative over the long run.

6. You have the ability to become skilled in at least some of the methods of environmental action.

The Methods of Action

If you agree with the ideas listed above, you will want to know something about the **methods** of environmental action. If we analyze all of the available strategies for action, we find that many of them can be grouped under four headings. These follow:

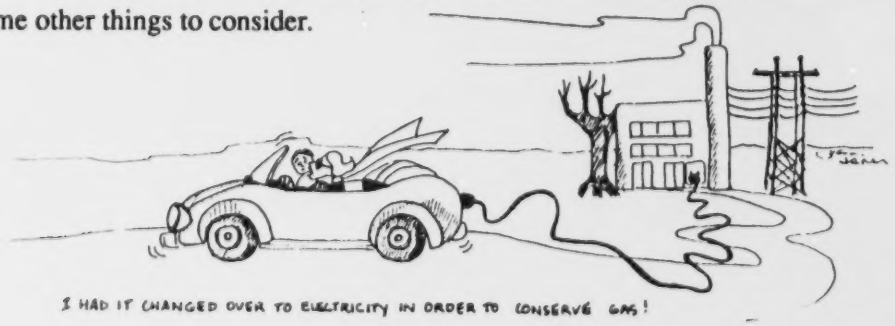
Action Method I - Persuasion: Persuasion is used when someone or a group of people is trying to **convince others** that a certain source of action is correct. How many times in your life have you tried to convince someone that your position is the right position? This takes persuasion to be effective, particularly if that person or group doesn't agree with you at first.

Action Method II - Consumerism: Consumerism relies on the power of the pocketbook or billfold. It involves **buying something** that agrees with one's philosophy or **not buying something** that represents an action or an idea one disagrees with. Consumerism is particularly effective if a group of people get together to take action. Even so, some individuals act alone in this dimension. Examples of consumerism? Refusing to buy soft drinks unless they are in returnable bottles. Refusing to purchase articles made in a foreign country which has a negative environmental policy. Buying products made by companies who try to reduce environmental pollution.

Action Method III - Political Action: Political action refers to any mode of action that brings **pressure on political or governmental agencies and/or individuals** in order to persuade them to take positive environmental action. In democratic nations, political action usually means supporting candidates who have positions similar to your own. It means pressuring people in office with letters, telegrams, and phone calls. It means casting a vote for or against a particular issue . . . and more.

Action Method IV - Ecomanagement: Ecomanagement is simply a word used to describe any **physical action taken with respect to the environment.** It can be illustrated by examples ranging from picking up someone else's litter to helping a private agency buy and preserve an ecologically-important forest. Ecomanagement, hopefully, results in either maintaining a good environment or improving a weakened environment.

These four methods of action are the ones that will be considered in more detail later. An additional method, **legal action**, is probably available only to adults and will not be described. However, before getting into an indepth discussion of the methods available to students, there are some other things to consider.



Individual vs. Group Action

Each of the methods previously described may be put into practice in one of two ways: 1) by individual action, and 2) by group action.

We have often heard people say, "I can't do anything about environmental problems because I'm just one person!" This is not true. There are many ways for the individual to take action - alone or by cooperating with private and public organizations. It is true, however, that an individual can't do all things. It is also true that an agency cannot do all things. It takes both!

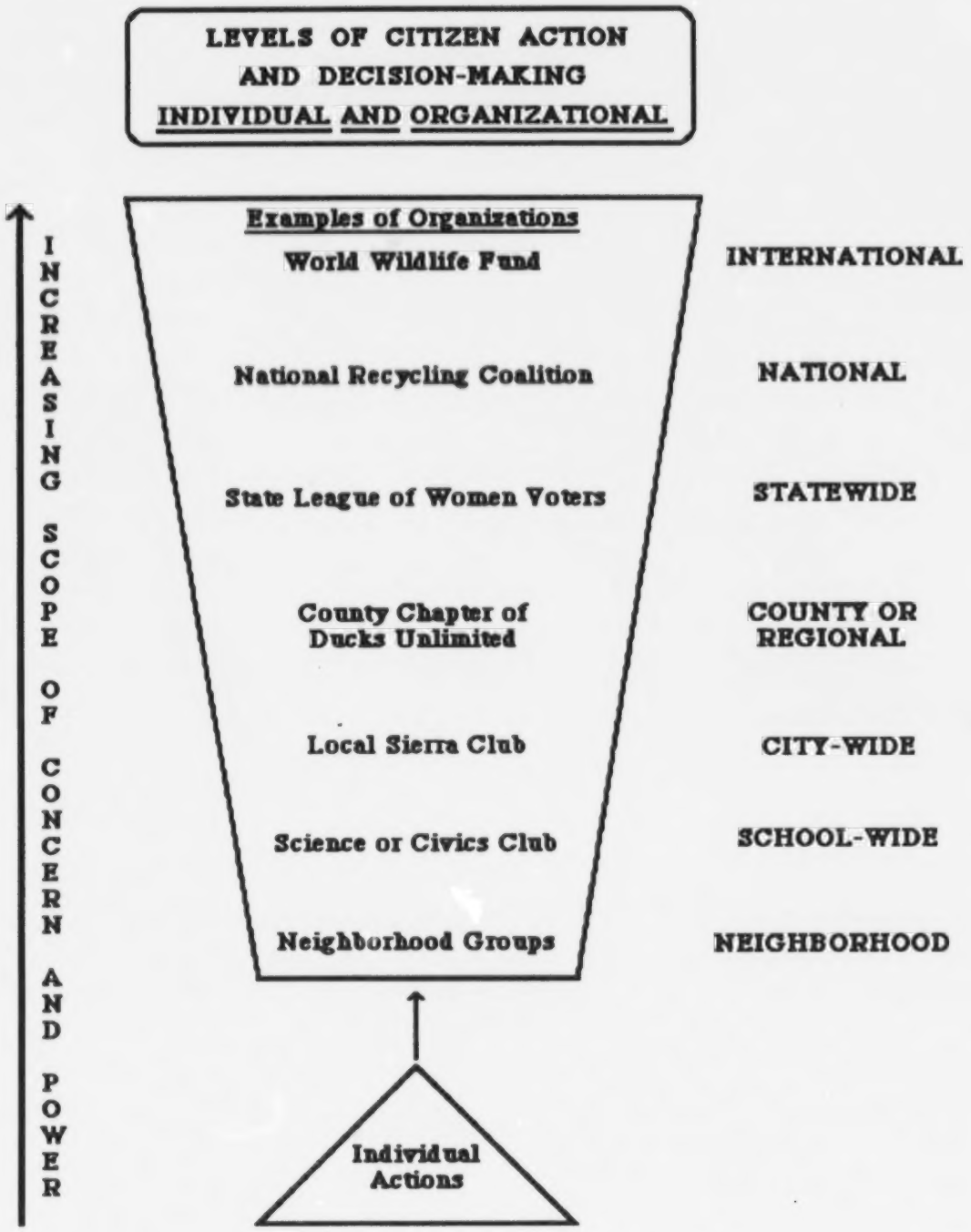
Let's consider an example. Our nation is facing a crisis because of the huge amounts of wastes being generated every day. The most environmental solution is for us to reduce the amount of material we produce, reuse goods as many times as we can, and recycle many of the wastes so that they are not thrown away. Yet, no government can do these things by itself. Unless individuals sort their household wastes into paper, plastics, glass, and metals, and become involved in the recycling process, the system won't work. We need the government or private business to establish the waste handling system, but every individual has to take appropriate actions or the system just won't work.

Both individuals and groups can take all four of the modes of action described earlier. Again, these are persuasion, consumerism, political action, and ecomanagement.

On the next page you will find a diagram. It shows different **levels of environmental action** - from individual action through the group action sponsored by international organizations. As you read upward, you will find that the actions (and groups) represent larger and larger regions. This also shows that the scope of the action also increases. However, this is not always true. There are times when the action of one individual or the actions of one small group can have a greater impact than the actions of larger corporations. Generally, though, it is true that the most power for action lies with well-organized and powerful groups.

It is also important to realize that groups are nothing more than individuals working together. Even international organizations such as Ducks Unlimited, get their power to act from individual human beings - some 150,000 of them. **Organizations** are no better or no more effective than the sum total of **individuals** belonging to that group. An organization can be a school student group or a national conservation group.

Many people are active both as individuals and as members of groups. Membership in environmental action groups has advantages other than broadening the individual scope of action. For example, one function of most environmental groups is to keep the individual members well informed on important environmental issues and to provide suggestions for appropriate action. This benefit alone increases the effectiveness of the individual wishing to take action. Paying dues or making donations to action groups also helps. This allows the


LEVELS OF CITIZEN ACTION
AND DECISION-MAKING
INDIVIDUAL AND ORGANIZATIONAL
INCREASING SCOPE OF CONCERN AND POWER
Examples of Organizations
World Wildlife Fund
INTERNATIONAL
National Recycling Coalition
NATIONAL
State League of Women Voters
STATEWIDE
County Chapter of Ducks Unlimited
COUNTY OR REGIONAL
Local Sierra Club
CITY-WIDE
Science or Civics Club
SCHOOL-WIDE
Neighborhood Groups
NEIGHBORHOOD
Individual Actions

individual to support action strategies which a person could not take alone because of poor personal skills or limited financial resources.

Even so, it is not the intent of the writers to tell you that you should be active either as an individual or as a group member. The intent, instead, is to let you know how to be active and to give you the necessary skills. The rest is up to you.

Guidelines for Decision Making

Many people take environmental action - both negative and positive - without the knowledge of where their actions will lead. This is unfortunate because one should not get on any bandwagon before thinking it through.

How does a person make a decision about whether to take action? It's not particularly easy if done right.

Let's assume that you want to take action on an issue. Can you think of some questions concerning the action that you ought to ask yourself before taking the action?

A few spaces below are provided. Write down questions that you think you need to answer before any action is taken.

Your Guidelines for Action Decision Making: (VI-4)

1._____

_____

2._____

_____

3._____

_____

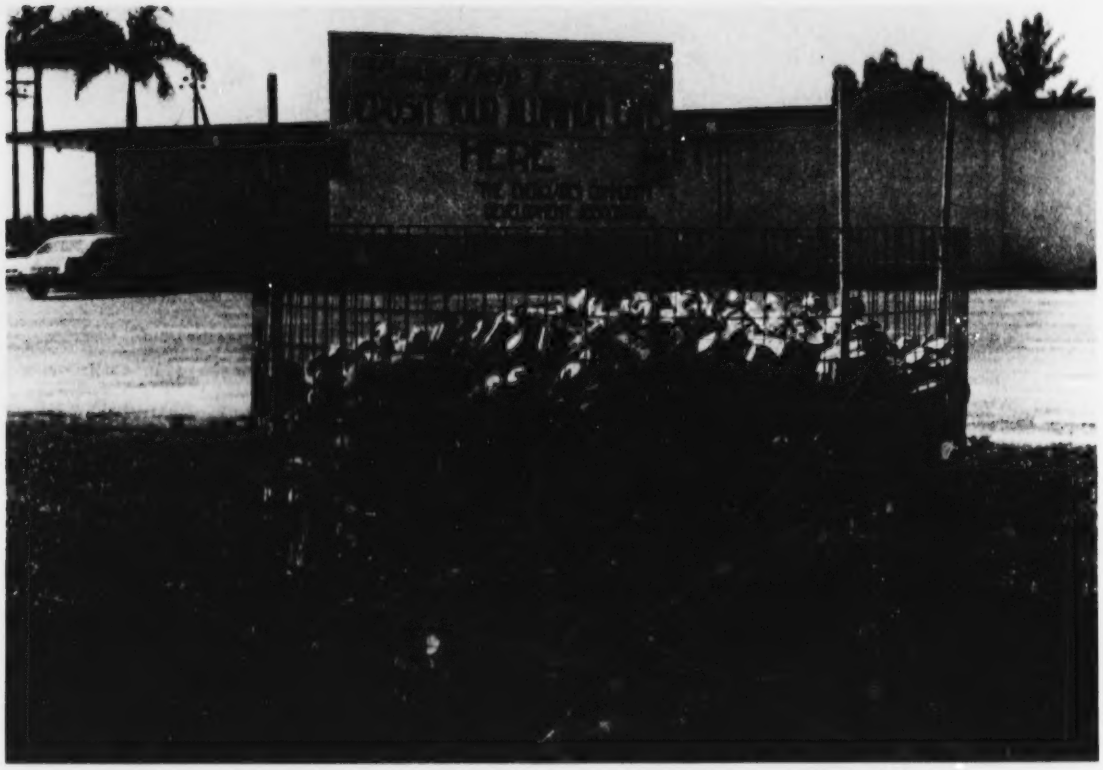
4._____

_____

Action Analysis Criteria

The authors have identified a total of fourteen questions that seem important to ask before proceeding with an environmental action. See if yours agree with those that follow:

1. Is there **sufficient evidence** to warrant action on this issue?
2. Are there **alternative actions** available for use? What are they?
3. Is the action chosen the most **effective** one available?
4. Are there **legal consequences** of this action? If so, what are they?
5. Will there be **social consequences** of this action? If so, what are they?



Recycling Cans in Florida
(Photo Courtesy of H. R. Hungerford)

Many environmentalists would argue that recycling aluminum cans is not as effective as using returnable bottles in the first place. Returnable glass bottles require less energy to make, use a more abundant resource (sand), and reduce the litter problem. Producing cans from aluminum ore has a very high environmental cost in terms of energy and this cost is reduced considerably by using recycled aluminum. Until returnable bottles replace aluminum cans on the market shelf, the environmental actions shown in this photo are necessary to lessen the many problems created by cans.

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6. Will there be **economic consequences** of this action? If so, what are they?
7. What are the **ecological consequences** of this action?
8. Do my **personal values** support this action?
9. Do I understand the **beliefs and values of others** who are involved in this issue?
10. Do I understand the **procedures** necessary to take this action?
11. Do I have the **skills** needed to complete this action?
12. Do I have the **courage** to take this action?
13. Do I have the **time** needed to complete this action?
14. Do I have all the **other resources** (other than the above) needed to make this action effective?

Have you identified a question that is not on this list that should be asked by someone who intends to take action? It might be an excellent one if you have. Discuss it with your classmates and your instructor. The questions above are useful in testing all the types of environmental action, whether it is political action, ecomanagement, consumerism, or persuasion.

Now it's time to practice using the action analysis criteria. Remember the report on incidents of tree spiking in California? Pretend that you are considering spiking trees belonging to a timber company. Ask each of these questions in terms of what you are considering - spiking one or more commercially valuable trees. Use the space provided below each question to write a response. [Note: You may have problems responding to some of these questions because you have only limited information concerning the redwood timbering issue. Your instructor may want you to go back to the original article (and others) for more information.]

Should I Spike the Trees? (VI-5)

1. To what extent is there sufficient evidence to warrant action on this issue?

_____

_____

_____

_____

2. Are there other alternative actions available for use? Yes ___: No ___. If so, what are they?

_____

_____

_____

_____

3. Is the action chosen the most effective one available? Yes ___; No ___. Why?

4. What are the legal consequences of this action?

5. What are the social consequences of this action?

6. What are the economic consequences of this action?

7. What are the ecological consequences of this action?

8. To what extent do my personal values support this action?

9. What are the beliefs and values of others who are involved in this issue?

10. Do I understand the procedures necessary to take this action? Yes ___; No ___.
11. Do I have the skills needed to take this action? Yes ___; No ___.
12. Do I have the courage to take this action? Yes ___; No ___.
13. Do I have the time needed to complete this action? Yes ___; No ___.
14. Do I have all of the other resources needed to make this action effective? Yes ___; No ___.

Decision: Do you think you would still go ahead with your plan to spike the trees? Please explain.

_____

_____

_____

_____

Using the fourteen action analysis questions provides important insight into the consequences and implications of a particular environmental action. This inspection process helps identify the most effective actions available. It is also critical when one is interested in achieving positive rather than negative environmental actions.

Your instructor may provide you with additional action problems to inspect by applying the criteria questions. In any event, the writers hope that these questions make sense to you and will provide an important skill needed for environmental decision making.

A Closer Look at the Modes of Action

Action Method I - Persuasion

Persuasion is a part of almost every environmental action. An environmentalist must first select an action he/she feels is necessary and correct. Then, others must be persuaded to join in the action so that it can be effective. People can be convinced to take a specific action by appealing to their sense of logic and/or emotion. Sometimes legal action is used to force (coerce) people who cannot be persuaded.

Taking all three types of these persuasive actions places a heavy responsibility on the individual. Whoever takes action must be sure that the reasons for taking action are sound and in the best interest of all concerned. Let's take a closer look at the three approaches to persuasive actions: logical , emotional, and coercive.

Making Logical Appeals

Persuasive actions of this type have long term effects, but are perhaps the most difficult to carry out successfully. Presenting a set of facts requires that the logic used be well thought out and accurate. The logic must also be presented in a clear and convincing manner. Also, it must be remembered that what is reasonable to you may not be reasonable to someone with a different set of values or a different educational background.

Putting Up Bluebird Boxes in Southern Illinois
(Photo Courtesy of H. R. Hungerford)

The eastern bluebird is threatened with extinction due to loss of nesting habitat. However, the bluebird is slowly increasing its population. Student groups such as this one have helped in the comeback of bluebirds by building and installing nest boxes in appropriate places.

What type of environmental action is this? Is there a need for similar project in your area? How could you find out?

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This type of conflict between values is clear in the nuclear power issue. Nuclear power has been proposed as a safe, clean, and available source of electricity. Environmentalists have often taken the position that nuclear power is not clean because because it adds small amounts of radioactive wastes to the air and produces liquid and solid radioactive wastes which must be disposed. Environmentalists also point that an accident in a nuclear power plant could have catastrophic results in death and damage, even though the chances of such an accident seem small.

Both sides in this issue are dealing with the same information (data). In the final analysis, the differences lie in values. Therefore, the logical arguments the two sides make with the same data are different ones. Those who desire the energy and economic security of nuclear power are willing to run the risks of the ecological problems. Most environmentalists prefer the risk of economic problems over ecological ones.

Unless new and important information becomes available on issues such as this, persuasive action will be difficult for either side.

Making Emotional Appeals

There are cases where environmentalists (or other activities) feel strongly that their action is a positive and logical one, but for various reasons choose to use an emotional appeal to persuade others. For example, an environmentalist may feel that an issue is too complicated for many people to understand. Yet, he/she wants these people to participate in the chosen action. Another reason for emotional appeals is that time may be too short for a thorough, logical treatment of the issue.

Emotional appeals can be very effective in getting people to take certain actions. When they are used, it is important to know that the actions are the correct ones. There have been many cases where emotional appeals caused people to take actions which later were found to have worse impacts on the environment than the original problem.

One good example of this is the issue of protecting feral (wild) burros in the California desert. Feral burros are the offspring of burros which escaped from prospectors and travelers in the early 1800's. By the 1900's the burro population had risen to a high level and some of the people began to hunt them for use as commercial dog and chicken food. The killing of these "sweet and innocent" animals produced an emotional outrage among many animal lovers. A strong appeal was made to officials to pass laws protecting the burros. Eventually this emotional appeal succeeded.

This decision was, however, a bad one ecologically. The California desert is a very delicate ecosystem. It has taken the desert plants and animals thousands of years to become

adapted for life there. One of the large native animals of the desert is the bighorn sheep. It has feeding habits which cause it to travel over a large part of the desert. This traveling prevents one area or one type of desert plant from being eaten too heavily. Also, this animal has a low rate of reproduction which keeps its numbers low.

The burro is not a native to the desert. It does not have habits which help it protect the desert in which it lives. It has few, if any, natural enemies. The large burro population is causing the bighorn sheep to disappear by competing for its food. It is also destroying the desert ecosystem as well. This is definitely a serious environmental issue. It is also one where there is a good deal of emotion on both sides.

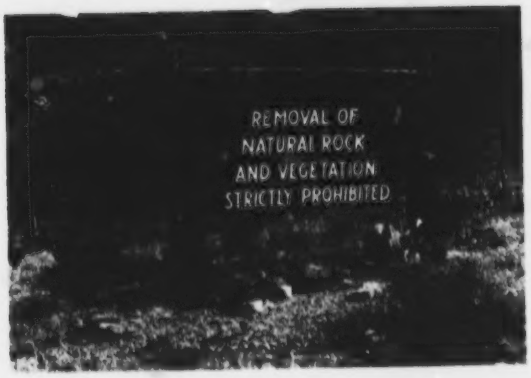
Other emotional issues involve the wild mustangs in Nevada, the harvesting of young seals in the Arctic, the killing of elk and grizzlies in Yellowstone National Park, the reintroduction of the red wolf into Kentucky, and protecting the elephant herds in Africa. In many cases the need for protection is real! However, there are obvious dangers in acting on the basis of emotional persuasion without getting all the facts. These kinds of issues show how important it is to consider all the facts when selecting environmental actions.

Coercion

Coercion is not really persuasive since it forces people to act in certain ways instead of allowing them to make up their own minds. However, it is discussed here briefly because it is sometimes used.

There are always some people who cannot be persuaded to act in the best interests of others unless they are forced to do so. For this reason, societies have laws and punishments which are intended to coerce the correct or desired behavior.

Environmentalists can use such laws to force others to take positive environmental actions. Other types of actions such as consumer boycotting also may be used to coerce others. (Consumer boycotting will be discussed later in this module.) Coercion, when used, can have serious consequences. Because of this, it is important that the person planning to use coercion checks the action against the fourteen criteria questions presented earlier.



Signs!!! We live our lives surrounded by signs of one sort or another. These photos here represent one kind of persuasion. Which kind of persuasion do you think is reflected in these signs? Why did you make the decision you made?

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The Best Approach to Persuasion

The authors feel that the best approach to persuasive action is a logical argument which helps others decide to take positive environmental action. Certainly, presenting a logical case is more effective if it is made in such a way that it appeals to the values (and/or emotions) of others. However, logical reasons should always be considered as well as emotional reasons for taking action.

Whatever persuasive action you choose, it probably will deal with one or more of the following strategies:

1. Making others **aware** of the need for action.
2. Helping others **understand** the need for action.
3. Getting others to **value** the need for action.

To illustrate these stages as they lead to action, consider the issue of high phosphate detergents. At one time, many housewives used detergents containing large amounts of phosphates which eventually fertilized rivers and lakes, causing an overproduction of plants. (This process is called eutrophication.) Eventually, this process caused severe water pollution problems.

In the late 1960's environmentalists began a campaign to make people **aware** of the problem. The next step was to help housewives **understand** the biological and chemical nature of the problem and to point out alternatives. Another part of the campaign told of the value of clean water in our lakes and streams. As a result of this persuasive campaign, many people boycotted high phosphate detergents and manufacturers began looking for less damaging detergents to put in supermarkets.

This is not the entire phosphate story, nor did environmentalists use only these kinds of actions. However, it does serve to illustrate the stages of persuasive action. Again, the key words are awareness, understanding, and valuing.

Many different methods exist which can be used at each of these three stages. A brief description of how some of these may be used follows:

Posters, newspaper ads, radio announcements, etc.: These are usually brief, eye/ear-catching things which serve best at the awareness level. They may also be used to appeal to the values of others. Their effectiveness is limited for providing extensive understanding of the issue.

Verbal discussions, speeches, letter-writing, debates, newspaper and magazine articles, etc.: These kinds of action are useful at all three stages, especially in presenting the facts of an issue.

Pond Eutrophication
(Photo courtsey of H. R. Hungerford.)

This closeup of a part of a pond shows the effects of fertilization on the growth of algae. Fertilizer in the form of nitrates and phosphates washed into this farm pond. The dense mats of green algae and other small organisms in the murky water are the result of these chemicals in the water. When the algae die what do you think the effects will be on the oxygen supply in the pond? The decay of dead plants uses up a lot of oxygen. What could happen to the fish population? Are there any bodies of water in your area which are the victims of this form of pollution? If so, what could be done about it?

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Modeling behavior: When one person takes action and others observe the action, it may serve to persuade them to do likewise. Picking up litter or using trash cans in the hallway would be an effective example of modeling behavior. This method can serve very well to make others aware of an issue, and even to make them check their own values.

Guidelines for Persuasive Action

There are some guidelines which should be followed to make persuasive action more effective. Perhaps you can think of others.

1. Be sure the basic argument can be easily understood by those being persuaded.
2. Be certain the case being presented is accurate, and the facts are correct.
3. Show how the desired action fits the values of others.
4. Select a method of persuasion which is clear, interesting, and appropriate to the issue.

Can you think of others?

Writing Persuasive Letters

To refresh your memory on letter writing, refer back to Module II. The general form of the persuasive letter is the same. Since letter writing is a common form of persuasive action when trying to get good environmental laws passed, the following guidelines are suggested for use when writing politicians. You may want to keep some of these in mind when writing persuasive letters to others as well.

1. Begin the main body of your letter with Dear Senator _____, Dear Representative, or Dear Governor_____.

2. In the first sentence, state the issue and how you wish the legislator to vote on the issue (or, in the case of the governor, how you want him/her to react to a proposed law). When referring to a specific bill, be sure to use its name and number.

3. It is best to limit each letter to a single issue.

4. Present the issue as briefly as possible. Describe your position and why you hold it. If you have detailed information to provide, organize the letter so that the reader does not have to wade through this in order to understand the meaning of your letter. Often, it is best to simply attach detailed information to the letter.

5. Never include disrespectful comments. Do not begin with statements like, "I know you won't read this but . . ." Be objective and courteous, never threatening.

6. Express your pleasure with any positive actions taken by the legislator or official. Often it is wise to devote a whole letter to praising some action taken which represents your interests. This lets the legislator or official know that he/she is on the right track.

7. Include a full return address so that the official can respond.

Activity: Classifying Persuasive Actions (VI-6)

Refer back to the story of the tree spikers reprinted earlier. While the actions of the tree spikers may be physical (ecomanagement) actions, they also are of a persuasive type. Classify the persuasion approaches taken by these people. Classify them as logic, emotion, or coercion. Defend your choice of classification. (VI-6)

Persuasion Type?

_____

_____

_____

_____

Your Defense:

_____

_____

_____

_____

Action Method II - Consumerism

Most consumer action can be classified under three headings: direct boycotting, consumer conservation, and indirect boycotting. Let's briefly consider each of these and how they could be applied.

Direct Boycotting: Boycotting means to **avoid buying certain products** for some reason. A product might be avoided because it has been found to cost the environment more than its worth. Non-recyclable drink containers, for example, have been found to have a high environmental cost. Since there are acceptable substitutes (recyclable aluminum cans) which have a much lower environmental cost, the need for non-recyclable containers is not really very

high. In this case, an environmentally concerned citizen would avoid buying beverages unless it was in recyclable containers. If enough consumers did this, beverage manufactures would be forced to produce more of the environmentally sound recyclable containers and discontinue the others.

Consumer Conservation: In some instances, a product may be found to have a very high environmental cost, but also a high need. A total boycott would not an acceptable environmental action because of the social, economic, ecological or other consequences. An example of such a product would be electrical energy.

Our society could not function without electrical energy. Yet, the effects of energy production on the environment are great. Whether electrical energy is produced from oil, coal, gas, or nuclear fuel, serious problems are created in the environment. These problems arise from mining, transportation, and/or air and water pollution.

An environmentalist conserves energy by using only what is necessary. **Ways to prevent waste** are investigated and used. This is consumer conservation.

Indirect Boycotting: When a consumer uses direct boycotting, it is to eliminate the environmental cost of the product itself. However, boycotting a product can also be used to **bring pressure on an individual or company to take an action unrelated to the product** itself. For example, environmentalists boycotted all Japanese goods in an effort to convince Japan that the harvest of endangered whales should be stopped. This action, an indirect boycott, helped convince Japan to consider changing its whale harvest procedures.

Action Method III - Political Action

Environmentalists are finding that some of the most effective actions they can take are political ones. Many decisions which influence our environment are made by government. Politicians must strive to consider all interests and values in finding the compromise answers which will be best for most people - now and in the future.

Environmentalists can help to make sure their interests and values are considered by taking an active part in the political decision making process. Essentially, **political actions** involve the skills and tactics of persuasion which were discussed earlier. The key is knowing how, when, and where to **apply those persuasive skills in the political system**. This requires a good understanding of how the political decision making process works at the local, state and federal levels.

Some of the major political actions which could be taken along with a brief discussion are presented on the following page:

Voting: This is the most obvious and easily used political action. When environmentalists organize their votes they can elect representatives who have environmental interests, or remove from office officials who have shown no concern for the environment.

Campaigning: Organized environmentalists have shown themselves to be very influential when they campaign for or against the election of some individuals. Political campaigning may involve the donation of time, money, or other resources to influence the election process.

Lobbying: Lobbying is the term used to describe actions you might use in trying to persuade politicians to make a specific decision. Lobbying actions can involve contacting politicians by letter, telegram, or in person to persuade them to vote for or against a proposed bill. When lobbying efforts are organized, these campaigns are very effective. Another form of lobbying is hiring professional lobbyists who spend all of their time trying to influence politicians. Most large industries and organizations have full time lobbyists. However, only a few environmental groups have enough money to afford professional lobbyists.

All kinds of political action are important ways for maintaining or improving the environment. To be able to use these actions effectively, you must be knowledgeable about the political process. This means using sources of information which will keep you informed on the law-making process, the environmental values of politicians running for office, and important issues which are currently being considered by government. Public news media (T.V., radio, newspapers) can keep you informed. Other vital sources of information are environmental organizations such as the National Audubon Society, the Sierra Club, or the National Wildlife Federation. These groups often organize letter writing lobby campaigns which can make your individual effort more effective.

Action Method IV - Ecomanagement

Ecomanagement requires a **positive physical action which will improve or maintain some part of the environment.** The selection of the action should involve careful consideration of the fourteen criteria questions. For example, some people might feel that damming a small stream to produce a pond would be an improvement to the environment. However, a closer look at the ecological consequences may show more harm than good.

Below is a short list of ecomanagement actions that you might wish to consider. As you read the actions, check off those you feel might be used in your own community or region. If you think of others, add them on the lines provided. (VI-7)

Ecomanagement Actions	**In Your Area?**
Erosion control projects	_____
Cleaning up neighborhoods or business districts (litter control)	_____
Starting a recycling center	_____
Conducting a scrap drive	_____
Landscaping the school grounds	_____
Improving wildlife habitat with projects such as	
Habitat planting projects	_____
Installing and servicing bird feeders	_____
Building and installing nest boxes for birds such as bluebirds and wood ducks	_____
Preserving important habitats for plants and animals that are native to the area	_____
Planting evergreen windbreaks to conserve energy during the winter	_____
Improving conservation practices such as . . .	
Turning off lights when not in use	_____
Repairing leaky faucets	_____
Putting weather stripping around doors and windows	_____
Lowering the thermostat	_____

What other ecomanagement projects can you think of? Make a list.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Irrigating a truck farm in Northern Illinois. (Photo Courtesy of H. R. Hungerford)

In this photo, river water is used to irrigate onions. This is a form of ecomanagement because it is a way in which humans modify the environment for food production. Would you rate this as positive or negative action? Can irrigation be both positive and negative? You might want to research the answer to this question.

Applying Environmental Action Skills

We have looked at the many aspects of environmental action. It is time to see how to apply them to environmental issues. This is not an easy task. But, it is important for you to see how the many aspects of action can be applied to a particular issue. Overall, it is extremely important for citizens to learn about and practice issue resolution skills.

In the introduction to this module several examples of students' environmental actions were cited. These action projects provide real life examples of how students used many of the ideas presented earlier in the module. Let's retrace the events that led to one of these projects, the Middle School Bottle Bill Coalition. A pair of middle school students became interested in non-returnable container deposit legislation (bottle bills). The students' interest in this topic led to their investigation of the issues involved in bottle bill legislation. As a result the students became convinced that a bottle bill would be a good idea for their state. In fact, they decided to take action to help get a bottle bill law passed.

With the help of their teacher and classmates, the students organized the Middle School Bottle Bill Coalition. They persuaded other area middle school classes (five schools and 200 eighth graders) to help lobby state legislators with petitions, letters, and personal visits. In fact, one class picked up cans from road side litter. Then they washed and smashed the cans, placing them in one pound bags. Having raised postage funds, these bags of can litter were then sent, along with a letter, to members of the state legislative Environment Committee. Their efforts gained the support of a number of state legislators. Bottle bill legislation was introduced into the state House of Representatives, but it failed to be enacted. However, legislation was passed which banned the use of "pull-tab" containers. The students, although they did not achieve their goal, believed their efforts helped influence the acceptance of the pull-tab ban. They also learned a lot about being responsible citizens!

This was just one example of how students used environmental action in an effective and positive way. The following section provides an opportunity for you and your classmates to plan environmental action. Your assignment will be to construct an "Issue Action Plan". Back in Module V you identified and investigated an environmental issue which interested you. You will now have a opportunity to carry that task to a final step. The activity below will ask you to analyze your research findings from Module V and, using these findings, to apply the action skills from Module VI in order to plan a campaign of action to help solve the issue.

Remember, your task is to plan. Whether or not you attempt to carry out the plan will depend on your values and whether your work in these modules has persuaded you that you should be involved.

ISSUE ACTION PLAN
(VI-8)

The Issue: _____

_____

_____

_____

Your Recommended Solution: _____

_____

_____

_____

The Action(s) You Intend To Take To Help Bring About This Solution:

_____

_____

_____

_____

_____

_____

Applying the Action Analysis Criteria

1. To what extent is there sufficient evidence to warrant action on this issue?
   There is sufficient evidence _____; there is not sufficient evidence _____.
   Why did you answer as you did? _____

_____

_____

_____

2. Are there other alternative actions available for use? Yes _____; No _____. If so, what are they? _____

_____

_____

_____

3. Is this action the most effective one available? Yes ___; No ___. Why?

_____

_____

_____

4. What are the legal consequences of this action?

_____

_____

5. What are the social consequences of this action?

6. What are the economic consequences of this action?

7. What are the ecological consequences of this action?

8. To what extent do my personal values support this decision?

9. What are the beliefs and values of others who are involved in this issue?

10. Do I understand the procedures necessary to take this action? Yes ___; No ___. What are they?

11. Do I have the skills needed to take this action? Yes ___; No ___.

12. Do I have the courage to take this action? Yes ___; No ___.

13. Do I have the time needed to take this action? Yes ___; No ___.

14. Do I have all of the other resources needed to make this action effective? Yes ___; No ___. What resources are needed?

Your Proposed Plan of Attack

Using a form you are comfortable with (or one prescribed by your instructor), describe your strategy for completing your action(s). This could be in the form of a flow chart, an outline, or a step-by-step listing. It should include an anticipated time table of events, people you will need to contact, resources you will need to collect and use, financial expenditures, etc. In describing your strategy, we want you to think through all that is necessary for allowing you to successfully complete your action(s).

Your Decision - The Action Recommendation

Taking into consideration the analyses you have just completed, state your final recommendation(s) for action.

_____

_____

_____

_____

_____

_____

_____

_____

_____

In Summary

The writers have attempted to introduce you to the knowledge and skills needed to identify, analyze, and investigate environmental issues. Further training was provided in the methods of environmental decision making and issue resolution. The writers believe that these types of educational experiences are critical for young people if life on earth is to remain ecologically stable.

Are you persuaded to work for a better environment? Hopefully, you are now part of the solution . . . . . and not part of the problem. The final decision is yours to make!

TEACHER'S EDITION

INVESTIGATING AND EVALUATING ENVIRONMENTAL ISSUES AND ACTIONS: SKILL DEVELOPMENT MODULES

PREFACE

TO THE TEACHER

Several years ago, a local junior high school science teacher sat in my office and complained about his district's science program. In his opinion, it was not meeting the needs of the learners. Further, he had gotten the feeling that there was some real interest, on the parts of the learners, for studying environmental issues. His goal was to give these students an opportunity to investigate these issues. Unfortunately, they lacked the skills to do this. What was the answer?

The program from which you are reading is the sixth edition of "the answer"! Over the years, this skill development program - culminating in autonomous research by the student - has been refined and thoroughly researched. In the mid 70's, the program was chosen as an outstanding, innovative science program by the National Science Teachers Association. In 1991, it was selected by the National Diffusion Network (NDN) and funding has been provided by the federal government for training associated with its implementation.

Even so, many have been the critics of the program! A number of teachers have commented that middle school learners simply could not do the things expected of them in independent research. Students didn't have the ability . . . there would be serious discipline problems . . . this was not how the teachers were taught to teach . . . classes would be out of control . . . on and on! As it turned out, these fears were and are unfounded. The teachers who believed in and used this program have found that middle school learners can do the work. There are no serious discipline problems.

But, using the program does demand a new style of teaching for many instructors. It demands that the students and teachers trust one another. It demands that the teacher be willing to give up being the focal point of instruction (especially during the investigation phase of the program) and serve as a consultant, resource person, and enthusiastic supporter of the students' efforts. Interestingly, those teachers with a willingness to do this have found the experience satisfying and, in large part, the students grateful for the experience.

Parental acceptance of the program also seems to be positive. I recall one evening at a critique session in a New Jersey junior high school where the program was being used in a team-teaching effort. I was introduced to a parent whose son was involved in the investigation phase of the program. The father said, "This is the first time in eight years of schooling that my son has had a meaningful assignment!" This was probably a bit of an overstatement, but it certainly made me feel good about what we were trying to accomplish. Teachers report enthusiastic acceptance by parents, not only in New Jersey but in other states as well.

At what grade level can the curriculum be used? The program was developed to be used primarily at the middle school level. However, it has also been used successfully with gifted fifth graders as well as with learners at the senior high school level. Interestingly, we are also using it at the undergraduate level at Southern Illinois University in the Teacher Education Program. Many of the collegiate students we come in contact with also lack the critical thinking skills taught in the program.

Research conducted on the program in urban, suburban, and rural schools shows rather dramatically that, through its use, middle school students become more able to identify problems and issues, conduct the research,. and investigate and evaluate possible solutions for societal issues. Further, and perhaps more importantly, research has shown that learners who have been trained in this program become far more active in their communities in a citizenship capacity. This observation, although extremely satisfying, was not totally expected by the developers. Yet, it did occur and this is exactly what education should be doing - developing active and responsible citizens.

Harold R. Hungerford
Southern Illinois University
June 1992

Teaching for Environmental Literacy

The authors of **Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules** have attempted to create a curriculum package which will assist middle and junior high school students in becoming environmentally literate. The modules are predicated on a particular definition of environmental education and a particular framework for environmental literacy. This definition of **environmental education** follows:

> **. . . that part of education which deals with ecologically-related social issues in the environment, and focuses on the development of responsible citizenship behaviors regarding those issues.**

This definition is oriented toward issues . . . issues which humans have created and which have ecological implications. It also recognizes that human behaviors are closely tied to the genesis of those issues and to the potential for resolution of those issues.

The attributes associated with environmental literacy are further defined in a set of literacy components which have been developed by two of the authors of these modules and Dr. Richard Wilke of the University of Wisconsin - Stevens Point. Those components include a **Key Component,** which describes the environmentally literate individual, and four subordinate **Literacy Components.** These components follow.

Literacy Components

The Key Component: The environmentally literate citizen is able and willing to attempt to make environmental decisions which are consistent with both a substantial quality of human life and an equally substantial quality of the environment. Further, this individual is motivated to act on these decisions either individually or collectively.

Literacy Component I - Ecological Foundations: In this component, the learner has sufficient knowledge of ecology to permit him/her to make ecologically sound decisions with respect to both humans and the environment. [Note: Although it is difficult to pinpoint the exact ecological knowledge which is critical and prerequisite to sound environmental decision making, certain key concepts appear crucial. The following concepts need to be understood in order to permit their application to environmental decision making.]

The environmentally literate person understands (conceptualizes) . . .

A. . . . Individuals
B. . . . Population Dynamics
C. . . . Interaction

D. . . . Interdependence
E. . . . Limiting Factors
F. . . . Energy Transfer
G. . . . Biogeochemical Cycling
H. . . . The Community
I. . . . The Ecosystem
J. . . . Succession
K. . . . Homeostasis
L. . . . Man as an Ecological Variable

Literacy Component II - The Awareness of Issues and Human Values: This component, like the previous one, seeks to provide the learner with conceptual information. Rather than ecological knowledge, however, this component deals with a wide variety of information related to environmental issues. Again, this knowledge is prerequisite to the actual investigation, evaluation, and remediation of issues.

The environmentally literate person understands (conceptualizes) . . .

A. . . . the way in which human cultural activities impact on the environment. Here, cultural activities would include economics, religion, politics, social customs, etc.

B. . . . the way various individual human behaviors impact on the environment.

C. . . . a wide variety of environmental issues and both the ecological and cultural implications of these issues.

D. . . . the various alternative solutions available for solving (or partially solving) discrete environmental issues. Of critical concern here would be the ecological and cultural implications of these various solutions.

E. . . . the need for thoroughly investigating and evaluating issues prior to taking environmental action.

F. . . . the roles played by differing human values in environmental issues. Also, an understanding of the genesis of these varying values appears crucial.

G. . . . the need for personal values clarification as an integral part of environmental decision making.

H. . . . the need for responsible citizen action in the solution of environmental issues.

Literacy Component III - The Investigation and Evaluation of Issues and Solutions: This component, unlike the two previous components, goes beyond the acquisition of information, per se. Component III deals with the development of those skills necessary for the actual investigation and evaluation of environmental issues. Further, it provides for the evaluation of alternative solutions for remediating those issues.

The environmentally literate person has those skills which enable him/her to . . .

A. . . . identify and investigate environmental issues using both primary and secondary sources of information.

B. . . . analyze environmental issues with regard to the various perspectives associated with those issues. Further, the learner is able to identify the ecological and cultural implications of these value positions.

C. . . . identify alternative solutions for discrete issues and the value perspectives associated with those solutions.

D. . . . evaluate alternative solutions for discrete issues with regard to their ecological and cultural implications.

E. . . . identify and clarify his/her own value positions related to discrete issues and to the solutions proposed for those issues.

Literacy Component IV - Citizenship Action: This component deals with those skills necessary for learners to take appropriate and responsible environmental action.

The environmentally literate person has those skills which enable him/her to . . .

A. . . . take either individual or group action (i.e., persuasion, consumerism, political action, legal action, ecomanagement) where appropriate for the purpose of solving or assisting to solve particular issues.

B. . . . evaluate environmental actions with respect to their impact on the quality of life and the quality of the environment.

Literacy, then, **begins with knowledge and ends with action**. Although these literacy components are, by and large, hierarchical in nature, there are many instances where two or more of the components can be acquired simultaneously (e.g., certain ecological knowledge and issue knowledge, or, issue information and the alternative methods of investigating those issues). In fact, to assume that each literacy component or subcomponent must be acquired independently of others is probably educationally unsound. There is far too much overlap between the components. Therefore, although hierarchical in nature, environmental literacy outcomes are interdependent and should be taught in this manner.

Achieving Literacy - What's Involved

As was stated earlier, environmental literacy starts with knowledge and ends with action. Although this statement sounds simple enough, its achievement is a complex task. There exists a relatively small, but growing, body of research on responsible citizen action and the factors which influence that action. What this research has discovered is complex, and what remains to be discovered is substantial. Nonetheless, it is important that instructors who use the modules become aware of what is known about the development of responsible citizenship behavior. And just what is known? At present it appears that there are seven variables which are crucial to environmental literacy. Those variables are presented in the diagram on the facing page, and a discussion of environmental literacy follows.

Action Strategies - Knowledge and Skills

Two of the strongest predictors of environmentally responsible behavior appear to be the **knowledge of action strategies** and **skill in using action strategies.** Research has provided us with substantial evidence that individuals, who are knowledgeable about environmental action strategies and skilled in applying them, will use that knowledge and those skills in efforts to remediate issues. Why might this be so?

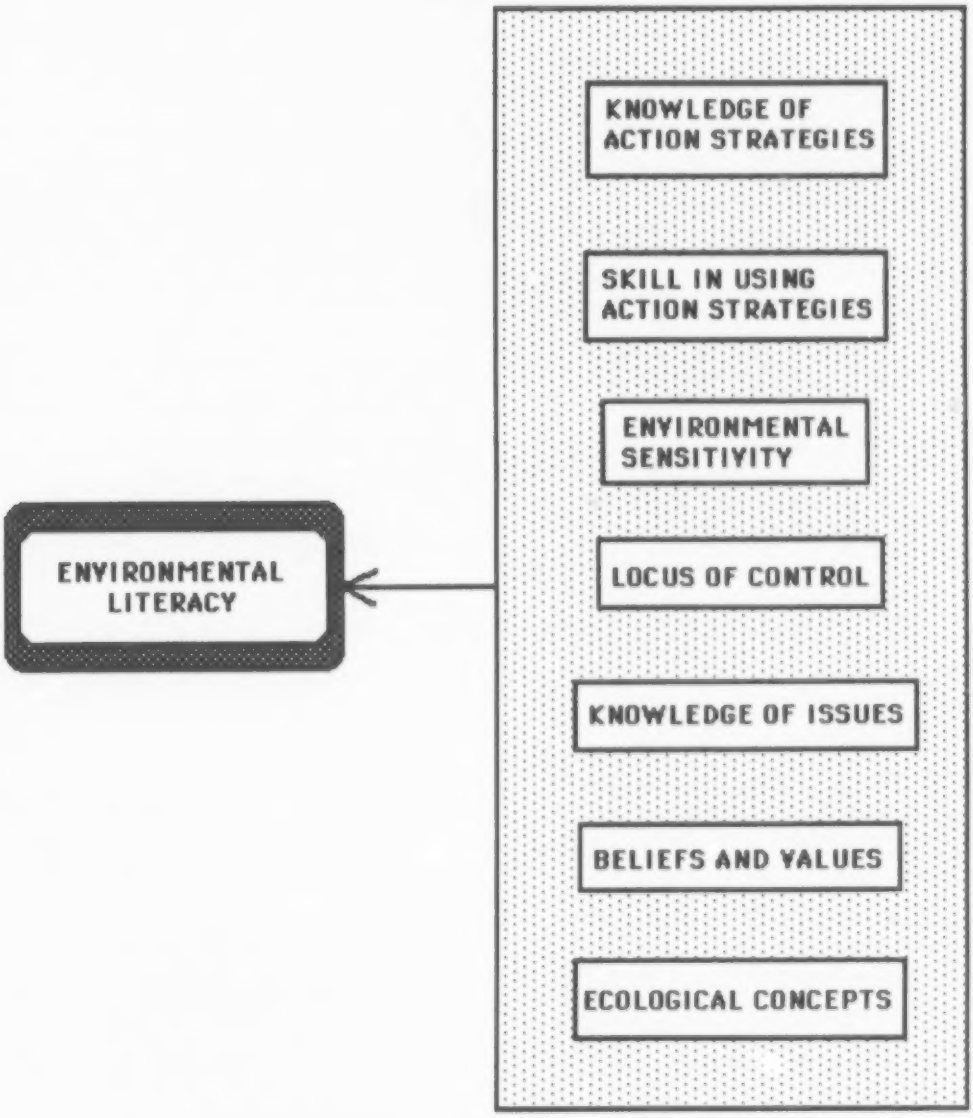
Research is not yet certain as to the entire meld of factors associated with this phenomenon, but it appears to be an important one. It might be that action knowledge and skills provide the individual with tools and mechanisms for bringing about changes . . . for making a difference and attempting to improve his/her world. If that is the case (and we tend to think that it is), than what we are doing is **empowering the individual to be a change agent in society**. If, in fact, students can be taught about citizenship actions and trained in their use, it seems likely that more citizens would eventually behave in environmentally responsible ways, i.e., more citizens would become actively involved in environmental decision making.

Fortunately, research tells us that the knowledge and skills associated with environmental action can be taught in the classroom. This has been demonstrated numerous times by both teachers and researchers interested in environmental education. The teaching of environmental education in classrooms across the nation could well be the key needed to unlock the door to some semblance of environmental literacy, nationwide.

Environmental Sensitivity

Research also indicates that another important predictor of positive environmental behavior is an attribute called **environmental sensitivity**. An individual who has a high degree of environmental sensitivity toward the natural environment is more prone to deal with the environment in ecologically appropriate ways than others. The sensitive individual (all other things being equal) is the one who . . . refuses to litter highways and natural areas . . . conserves natural resources . . . works to preserve ecologically important natural areas . . . strives for a stable and appropriate human population level . . . respects hunting and fishing laws . . . insists on rational zoning requirements . . . etc.

YARIABLES ASSOCIATED WITH ENVIRONMENTAL LITERACY



THIS FIGURE ILLUSTRATES THE IMPORTANT YARIABLES ASSOCIATED WITH ENVIRONMENTAL LITERACY WHICH ARE DISCUSSED IN THIS SECTION. EACH OF THESE YARIABLES INTERACTS WITH ALL OTHERS. THE EXACT NATURE OF THESE INTERACTIONS IS NOT KNOWN BUT THERE IS SUBSTANTIAL EVIDENCE THAT THEY DO OCCUR.

What is **environmental sensitivity**? It is, by and large, **an empathetic or understanding view of the environment**. It is a view that respects ecological integrity and one that believes that humans must live, somehow, in ecological harmony with the natural environment.

If sensitivity is such an important variable, why not focus on it solely and change the perspective of every youngster in the schools of the world? Unfortunately, this is easier said than done. A high degree of sensitivity seems hard to come by and is apparently a long time in developing! Research, again, indicates that the very sensitive individual is the one who grew up in close proximity to a natural setting, and who spent considerable time in that setting. Given the current economic climate, it appears unreasonable to suppose that educational systems will be able to provide frequent and extended experiences in the out-of-doors for youngsters. However, there are some ways in which the teacher might be instrumental in developing the important attribute of environmental sensitivity?

Many sensitive individuals also report another factor as being crucial in their development. That factor is associated with role models. The person(s) who acted as the role model(s) demonstrated a high degree of sensitivity that was emulated by the recipient of that experience. Role models were often members of the immediate or extended family. In a number of cases, the role model was a teacher.

Since teachers were sometimes reported to be precursors to sensitivity, it appears that there is some opportunity for the classroom teacher to make a contribution to the development of environmentally sensitive individuals. However, the teacher would have to fit the sensitivity model rather well, reflect it diligently, and have such a positive relationship with students that they might wish to emulate him/her.

Locus of Control

The school (and the classroom) teacher is in a position to be influential in relation to a fourth environmental literacy variable, **locus of control.** Research suggests a relationship between how a person behaves and that person's locus of control. Locus of control is a factor associated with an individual's perception of whether a particular behavior will result in an anticipated outcome or reinforcement for repeating the act. This perception is called **expectancy of reinforcement.**

Some individuals believe that they are in control of situations which demand action. These individuals have a high expectancy of reinforcement. Such people are said to possess an **internal locus of control. "Internal" individuals would tend to take action on an issue because they feel that their actions would, in some way, be effective,** i.e., their actions would help resolve the issue.

On the other hand, some individuals believe that they are not in control. Therefore, they have a low expectancy of reinforcement. These individuals are said to have an **external locus of control**. This simply means that **the individual believes that the control of the**

situation lies external to him/her. "External" people may, for example, believe that "powerful others" are in charge and will dictate the outcome of a problem or issue.

An example might be helpful here. Let's consider the issue of human overpopulation for a minute. Who do you suppose might be more apt to use contraceptive methods while engaging in coitus? One would expect birth control to be more widely utilized by individuals who felt in control of conception, rather than those who felt that conception was determined by chance, or by some powerful other. And research indicates that this is the case. Internals tend to use contraception while externals do not.

Are internals and externals consistently one way or the other? Research is unclear on this point, although we know that some individuals have a marked external nature while others reflect an internal nature. But, there is also some evidence which indicates that people may be internal in certain situations and external in others. There is also some evidence which indicates that some individuals can, indeed, be motivated to move from an external perspective to an internal one. If this is correct, there are important implications here for environmental education. Although it is unclear precisely what the factors are which are involved in such a change, it is more probable that an external will move toward an internal perspective if he/she: 1) understands the issue in depth, 2) believes that action is called for, and 3) knows which action might maximize the possibility of exercising control over the outcome. If this is correct, environmental educators should focus on crucial issues, delve into those issues in depth, and provide training in citizenship action skills which can be applied to those issues.

Knowledge of Issues

The focus on crucial issues (mentioned in the above paragraph) is related to still another variable which appears important to environmental literacy, i.e., the **knowledge of issues.** It must be stressed that knowledge about issues, in and of itself, is not enough to promote responsible citizenship behavior with respect to solving environmental issues. The reliance on knowledge to "get the job done" is commonplace in environmental education (and in education in general!). Yet, most research shows that an awareness of issues (i.e., simply knowing about them) is insufficient in terms of changing behavior.

There is some evidence, on the other hand, which indicates that an **indepth investigation** of an issue may promote changes in human values and lead to overt action with respect to that issue - at least with some individuals. However, in order to be effective, the investigation or information input must be thorough and fairly exhaustive. The process of indepth investigation might have an added benefit. It appears that through the investigation process, which demands a considerable investment of time and effort, **a student develops ownership of the issue under investigation.** A particular issue becomes **his/her** issue. Thus, ownership becomes a potent motivator to take action in order to bring the issue to resolution.

The statement was made previously that knowledge of issues alone does not necessarily promote environmentally responsible behavior. That is because a person's **perception** about an issue is shaped by much more than just what he/she knows about it. An individual's perception about an issue also depends heavily upon his/her beliefs and values related to that issue.

Beliefs and Values

Beliefs and values are complex and interrelated. **A belief is nothing more than an idea which an individual holds to be true.** It may or may not be accurate, i.e., it may not be substantiated by reality, but it is what the individual believes to be true. **A value can be defined as the relative worth an individual places on something.** It appears that values grow out of an individual's personal experiences and background.

If a belief is erroneous, an individual's values and behaviors can be biased in an ecologically faulty manner. The idea that "Having three or more children poses no environmental threat" is a belief statement. It describes what an individual perceives to be reality. In this case, the belief is probably wrong. It does not describe a true relationship between family size and ecological stability (from a population dynamics perspective). The comment that "Large families contribute to emotional stability and are good for society" is also a belief statement. It implies both human health and social values placed on large families by the individual.

A person's perception about a discrete environmental issue arises from an integration of his/her belief and value systems. It would appear that an individual's behavior regarding an issue is influenced by his/her beliefs and values (perception) related to that issue. Note that we said influence, and not dictate. Why? You must remember that individuals hold many beliefs and values. Consider, again, the above example. We would be hard-pressed to dictate that individual's reproductive behavior. This is simply because value perspectives related to cultural mores, religious teachings, and economic constraints (to name a few) are also present.

In order to promote environmentally responsible behaviors, environmental educators must deal with the beliefs and values of students. This is a real problem when one realizes that each learner has a unique set of beliefs and values which results in a very personal frame of reference concerning an issue or a group of issues. How does the teacher go about dealing with these diverse and complex entities in an effective manner?

First of all, indoctrinating students with "correct" values is undoubtedly counterproductive. To directly confront a student's value system will usually result in a deepening commitment to previously held values. In addition, indoctrination is highly unethical. In a democratic society, educators must strive for honesty in instruction and work for the development of effective problem solvers and participatory citizens. If teachers help students become skilled problem solvers (e.g., investigators and evaluators of environmental issues),the students will probably sort through their own values with respect to environmental concerns

and, in almost all cases, line up on the side of environmental integrity. The reader should note these words are more than just educational "catch-phrases"; there is evidence that this prescription does, in fact, work.

Ecological Concepts

Helping students to become skilled "evaluators" of environmental issues is related to the seventh, and last, environmental literacy variable. When an individual makes a decision concerning an issue, that decision will have ecological consequences if carried out. Thus, it is critically important for the individual to have a grasp of **ecological concepts** in order to assess the ecological consequences of a given decision. You may recall the key component of environmental literacy which was stated earlier. That component states that environmental decisions should be consistent with both a quality of life and an equally substantial quality of the environment. **Environmental quality is, in large part, dependent upon the ecological integrity of the environment.** Thus, a strong grasp of ecological concepts becomes crucial to the decision-making process.

In Summary

There appear to be a number of variables which are influential in the development of **environmental literacy**. Each of these variables is important in its own right, and each appears to interact with all others. Further, exactly how these variables interact with each other is unknown. It would seem foolish, however, to ignore what is known about these variables. They simply are the best way presently known to promote a type of responsible reaction on the part of students (and citizens) when it comes to environmental issues. As you examine the contents of **Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules,** you will find that they integrate almost all of the variables associated with environmental literacy. And, as your students work through the modules, we think you will be pleased with their growing ability to tackle serious environmental issues and with their eagerness to become involved in positive action toward remediating those issues.

Introductory Information to the Modules

The Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules have been developed to accomplish a dual purpose. First, they are designed to prepare middle and junior high school students to investigate and evaluate environmental issues in an **autonomous** manner. The first five modules afford the students an opportunity to become independent researchers into environmental issue areas. These modules set the scene for research and provide the learner with the knowledge and skills to conduct research.

However, the authors believe that research without subsequent environmental action is not enough to make an individual environmentally responsible. Hence, a second purpose of the modules is to introduce the students to the various modes of citizenship action so that they might couple environmental issue awareness with activity which initiates constructive change. Module VI has been developed to present various action strategies and provides opportunities for both surrogate and real environmental action planning. The final and ultimate step - that of initiating and completing the planned action - is a decision left up to the instructor and his/her students.

These modules have been written as a consequence of the authors' observation that middle school students are ill-prepared to research environmental issues using primary and/or secondary sources of information. Similarly, these youngsters are ill-prepared to assess the appropriateness of positive environmental action, and to initiate it when it is called for. Early attempts to provide a learning climate in which middle school youngsters could apply their own environmental interests to a research-oriented strategy was only marginally successful, even under the direction of highly competent instructors. The students simply did not have the skills necessary for a successful interaction with environmental issues. This modular program has been developed to provide those skills so that students of varying abilities can become truly autonomous learners and responsible action takers. It is the hope of the authors that your students will reach a point (after interacting with these modules) at which they desire and do take action based on the research they have done.

Grade Levels and Instructional Time

The **Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules** were designed for middle school students and care has been taken to maintain a reading level appropriate for students of these grades or abilities. The modules have been successfully taught with gifted students in intermediate grades and with students from the sixth through twelfth grades, as well as with college students. The sophistication of autonomous research projects accomplished by particular students is, of course, related to the maturity level and skill competence of students at particular grade levels.

How long should you plan for teaching the modules? Many variables impinge on teaching the modules, just as with any other instructional strategy. The actual training portion of the modules (Modules I-IV and VI) takes approximately one semester (18 weeks, 50 minutes/day, 5 days/week) to complete with "average" middle school youngsters. This time must be lengthened with younger, less skilled students, and may be shortened with older, more sophisticated students. Additionally, instructional time might be shortened if two or more teachers combine their expertise and class time to team teach the modules. Great success has been experienced, for example in situations where a science and a social studies (or language arts) teacher pool their talents.

The time needed for Module V (**autonomous research**) varies greatly depending on the nature of the research conducted. Some students can effectively engage in and complete autonomous research in less than six weeks, others require a longer period of time. We suggest that once all students appear to have their research well under way, the teacher may wish to allow part of the school week for autonomous research, and to use the remainder to initiate Module VI. This would appear to provide continuity between research and action. The time necessary to complete a planned **action project** will also vary - dependent upon the action chosen and the competence of the students. Many teachers prefer to complete Module VI and then to provide "action time" outside of the usual classroom period, e.g., during the lunch, activity, or study period, or before or after school. This allows the teacher to move on to other topics in the classroom and still to provide opportunity and support for action projects which his/her students elect to undertake.

Assumptions On Prerequisite Knowledge

These modules do not include an ecological foundations component. That is, they were designed on the assumption that a student interacting with them would already have a foundation in the basic ecological concepts which explain the operation of the biosphere. The knowledge of concepts such as energy transfer, population dynamics, homeostatic balance, community and ecosystem interactions, etc. is essential for understanding the ecological basis of environmental issues and solutions. The authors have assumed that students will have much of this information. This assumption may be faulty in some instructional situations. Therefore, the following references are recommended for those instructors who feel that their students need ecological foundations instruction before they engage in the materials presented here.

Title	Supplier
Project Wild by the Western Regional Environmental Education Council (WKEEC) [activity guides, elementary & secondary]	Project Wild Salina Star Route Boulder, CO 80302

Title	Supplier
Aquatic Project Wild by the WKEEC [activity guide, K-12]	Project Wild Salina Star Route Boulder, CO 80302
Basic Ecological Concepts by Audrey Tomera [worktext, 7th-8th grade]	J. Weston Walch, Publisher 919 Congress Street Portland, Maine 04104
Ecology: Interrelationships in Nature by H.R. Hungerford & A.N. Tomera [8 sound filmstrips]	Society for Visual Education 1345 Diversey Parkway Chicago, Illinois 60614

Comments On Instruction, Skills, And Evaluation

Like so many other teaching strategies, the success of this modular design depends to a large extent on the teacher. As with any learning experience, the student becomes much more proficient under a dynamic, empathetic, and cognitively demanding instructor. Likewise, the sophistication to which students will develop investigation, evaluation, and action skills is closely related to the standards established by their instructor. The successful acquisition of those skills in Modules I-IV and VI usually lies along a continuum ranging from marginal achievement to outstanding criterion performance. It is up to the teacher to guide his/her students as close to criterion performance as possible. Achievement less than this will be reflect on the students' success with autonomous research Module V) and responsible citizen action projects (chosen after Module VI).

The **Investigating and Evaluating Environmental Issues and Actions: Skill Development Modules** are quite compatible with current goals in science education, as described by authorities in that field. These modules focus on science-related social issues and on Science-Technology-Society education as recommended by the **Project Synthesis** report., as well as on the investigation skills of science.

Also included within the modules are those skills normally associated with the social studies and language arts, e.g., written communication, identifying, clarifying, and analyzing values, letter writing, writing summaries, library reference skills, conducting surveys, collecting opinionnaire data, and using questionnaires. The action modes, discussed in Module VI, carry on the integration of subject matter in a relevant societal context, e.g., analyzing written communications, identifying, clarifying, and analyzing values, proceeding with due political process, assessing environmental impact of products, and evaluating the ethics of action methods. Many of the above skills are also those described by the **National Council for Social Studies** in its Scope and Sequence of Skills recommended for the social studies.

A careful examination of the performance objectives listed at the beginning of each module, reveals that there is a strong emphasis on the critical thinking skills, i.e., on those skills considered to represent higher order thinking. In order to develop into successful and responsible problem solvers, students must become proficient in analysis, synthesis, and evaluation skills. These modules enable you, as the instructor, to guide and assist your students in their development of those very behaviors.

The integrated nature of the skills impinging on environmental education makes a logical and convincing case for an **interdisciplinary teaching approach**. Where a school is departmentalized, cooperative planning and implementation of this modular strategy is recommended for the teachers of science and social studies and/or English (language arts). However, if necessary, either the well-trained social studies or science teacher can handle it alone. Similarly, the modules can be (and have been) taught by generalists in self-contained classrooms.

The authors have used a particular **teaching approach** in developing these student materials. As each topic or behavior is first introduced, it is identified, defined, or operationalized for the reader. The skill or behavior is then modelled for the students using the proper format or guidelines identified in the first step. In the final stage, the students participates in an activity in which he/she can apply both the definition and the model in an actual situation. This format of **skill identification, model presentation, and skill application** is believed to be a sound framework for learning. If at any time, the instructor feels that further application situations are necessary, he/she should not hesitate to provide them for the students.

The skills approached in these modules are similar to, if not the same as, investigation and citizen action skills needed in many everyday life situations. The modules also encourage the transfer of investigation and action skills to many phases of decision-making. Transfer is a much cherished goal of education, and to this end these modules are dedicated. Students and adults live in a world where they will be called on to make decisions and to take actions based on accurate information and sound logic. As instructors, it is our responsibility to begin to give youngsters opportunities to learn how to do this.

Every effort has been made to produce a modular strategy that incorporates a **hierarchy of skill development.** This hierarchy necessitates close attention to the sequence in which the modules are taught.

The authors recommend that, in situations where **one instructor** is teaching the entire program (e.g., departmentalized science or social studies, self-contained classroom teacher, teacher of gifted and talented), the students experience the modules in the sequence in which they are written. Module V (autonomous research) requires students to reach criterion performance on the skills presented in the previous modules, and therefore **must** be taught subsequent to Modules I-IV. Module VI should be approached after students have their research well underway. Students, however, will need the information generated in their issue investigation in order to make sound decision concerning action plans, so although

some overlap of Modules V and VI may be useful, the bulk of the autonomous research should be completed before students get too far into action training and planning.

In situations where **several instructors** are involved in a team teaching effort, careful sequencing is still beneficial. Module I is clearly an introduction to environmental issues, beliefs and values, and, as such, should be the initial module. However, Module II could easily be taught concurrently with Modules III and IV. Module II (secondary sources of information) would be quite appropriate in a language arts or library skills class, while Modules III and IV (primary data collection and interpretation) would be applicable in both science and social studies classes. As was stated above, it is imperative that Modules I-IV be completed prior to Module V, and that Module VI be initiated after the autonomous investigations are approaching completion.

Although careful sequencing of the materials should be followed, it will sometimes be the case that a particular group of students will already be proficient in in some of the skills covered in Modules I-IV. It is recommended that the instructor assess the students to ascertain this proficiency and then move on to more pertinent modular materials rather than unnecessarily repeat materials.

As stated earlier, the modules incorporate a hierarchy of skill development. The entire program begins with instruction in analyzing issues and ends in independent research and action planning which demands students application of a number of related skills. Further at each step of the way, a product is produced by the student which enable the instructor to evaluate progress. No formal tests are used in any of the modules. However, **performance objectives are specified** for each of the modules, and are presented to the student. Since evaluation is implicit in the training activities of Modules I-IV and VI, student performance in terms of those objectives appears to be a most logical means of evaluation. The content for **summative evaluation lies in the products produced by students during their research** (Module V) **and citizen action planning** (Module VI).

Comments on Values and Values Clarification

By virtue of the subject matter of Module I and Module VI, the instructor must become well-versed in language arts techniques, economics, and political science content of the social studies, and ecologically-related science topics. These modules contain the essence of environmental education, a truly interdisciplinary endeavor. Arguably, one of the most important teaching skills to be used with these modules is the use of **values clarification techniques.** In most activities, conclusions and answers are not cut and dried. Students should be encouraged to analyze issues, weigh actions and estimate environmental costs. **The instructor's task is to challenge the student's thinking, query the correctness of the information used by the students in choosing alternatives and, above all, permit and encourage the exposure of as many beliefs and values as exist within the classroom and/ or world concerning issues and actions.**

Emphasis on values clarification is sound. Modelling of values can be another sound teaching practice. However, students see so many conflicting values being modelled that there is simply is no guarantee the "appropriate" values will be adopted. And, since research indicates that didactic teaching of values is ineffective, it appears that values clarification may be the best alternative for dealing with values in education.

Teachers have often asked whether they should permit their own values to be known to their students. By all means, **share your values** with your students. But make sure your students understand the ecological consequences of those values, and share them as being one way to view a situation - not dogmatically. An open atmosphere of free, respectful exchange between students and teacher will increase the value of the activities in the modules.

For indepth discussions of values and values clarification techniques, the teacher is referred to the following sources:

Knapp, C. Attitudes and values in environmental education. **The Journal of Environmental Education,** 3 (Summer, 1972), 26-29.

Harmin, M., Kirschenbaum, H., and Simon, S. **Clarifying Values Through Subject Matter**. Minneapolis, MN: Winston Press, 1973.

Raths, L., Harmin, M., and Simon, S. **Values and Teaching**. Columbus, OH:Charles E. Merrill Books, Inc., 1966.

Scherer, D. **Personal Values and Environmental Issues.** New York, NY: Hart Publishing Company, 1978.

Simon, S., Howe, L., and Kirschenbaum, H. **Values Clarification: A Handbook of Practical Strategies for Teachers and Students**. New York, NY: Hart Publishing Company, 1972.

Research Results

These modules have been in existence, in one edition or another, for over a decade. During that time, a number of studies have been completed either by the authors or by Masters or Doctoral students as they search for advanced degrees. Numerous variables associated with issue investigation instruction have been investigated. These include but are not limited to: (1) changes in belief systems [with respect to issue solution], (2) changes in students' overt environmental behavior, (3) students' knowledge of environmental action strategies, (4) students' perception of their ability to use action strategies, (5) students' environmental sensitivity, (6) changes in students' locus of control, and (7) teachers' ability to learn the rudiments of issue instruction.

Researchers have found that, for the most part, instruction using the modules does not influence environmental sensitivity. This is not totally unexpected because sensitivity research indicates that this variable is impacted more by out-of-school experiences than by direct instruction. But, with this one exception, the modules have "passed their tests" with flying colors. It is extremely rewarding, for example, to find that students who have been exposed to good modular teaching do, indeed, participate in much more responsible citizenship behavior outside of school than do those who have not had this same experience. This research finding has been demonstrated several times with remarkable success. Similarly, students do seem to feel empowered to make a difference as citizens, a characteristic associated with "locus of control".

Student groups which have been researched include those in urban settings, small towns, and rural schools. It doesn't seem to make much difference where the student is from - changes are observed. Similarly, research has shown rather dramatically that many different ability levels can profit from using the modules.

Educational philosophers have, for many years, touted the need for teaching for responsible citizenship behavior. Some have even gone so far as to recommend getting students involved in social issues. Indeed, environmental issues are science-related social issues. And, we know that, with the use of the modules, students are attempting to be change agents in society. And, some of them are being successful. Few curricular programs can make this claim and support it with research findings. The authors of this particular program have, honestly, been surprised by the extent of its effectiveness. Nonetheless, they are very pleased and wish that more students could experience this same instruction.

MODULE I

ENVIRONMENTAL PROBLEM SOLVING

Overview

In Module I, the students begin by defining the term "environment", and discussing the concept of environmental interactions. Subsequently, they analyze a set of environmental interactions in terms of human impact on the environment, and explore the relationship between the quality of human life and the quality of the environment. With these understandings in hand, they turn to the definition and identification of environmental problems, and analyze one problem in terms of the issues which arise from that problem. After a brief examination and discussion of their own beliefs and values relative to specific environmental issues, the students gain experience in identifying the differing players, positions, beliefs, and values which are inherent in specific environmental issues. Finally, students apply their knowledge of environmental issues, beliefs, and values to problems of their own choosing. (Specific objectives for Module I can be found on page 2 of the student text.)

Suggestions for Teaching Module I

Research reveals to us that, by and large, students learn what they perceive we want them to learn. This observation serves as one of the major bases of the behavioral teaching model. Module I (and the following modules) incorporates a set of performance objectives for students. It is strongly recommended that the teacher review the objectives with students before initiating each module. It is also highly desirable for the teacher to discuss with students the **major objective** of this modular program, i.e., **the development of a skilled and autonomous learner.** This major objective should be communicated in a manner that is intended to **generate a feeling of worth and ability on the part of the student,** and to alert students to the final outcome of this curriculum.

Getting started. Middle school youngsters are extremely interested in the condition of the world around them and in environmental issues. Still, some suggestions for introducing the modules may be helpful to the first-time instructor of this curriculum.

One very capable teacher reports that he gets his students "turned on" to environmental concerns with the **Environmental Quality Index** (EQ Index) published annually by the **National Wildlife Federation** (usually found in their February issue). This index presents a lengthy summary of the current status of environmental quality relative to various environmental areas, e.g., water, air, endangered plant and animal species, etc. This teacher divides his students

into groups, assigns each group a particular area to study, to discuss, and to report about to the entire class.

Teachers have also introduced the modules by starting an **"issue bulletin board"** at the beginning of Module I, or several weeks prior to its beginning. It would be a good idea to post clippings on environmental issues of local and regional concern, and to invite students to contribute to the board. It is probably not important, at first, whether issues or problems are contributed. The contributions may be used in a classification activity after students have gained an awareness of differences between environmental problems and issues, and between those which are environmental in nature and those which are not.

Still other teachers report success in initiating Module I with **The Lorax** by Dr. Suess (This selection is widely available, in print form, as a 16 mm film, and on videotape.) This story or allegory of environmental degradation and loss seems to fascinate youngsters of many ages, and can serve as a focal point in Module I's discussion of human interactions with the environment, ecological impacts of environmental interactions, and differing beliefs and values related to environmental issues.

Exercise I-1 (p. 3). Students begin their study by defining the term "environment". The definition of this term usually includes **all the factors in an organism's surrounding which influence it**. Students tend to focus their initial definitions on variables which exist in their own surroundings. Although this is a good place to begin, it probably reflects a very narrow perspective of the environment. The prose which follows this activity is designed to help students realize that **the environment includes much more than what immediately influences them,** rather it also includes **other human beings, other living things (plants and animals), and non-living things, as well.**

A comprehensive concept of the term "environment" will have important implications in dealing with environmental problems and issues. Therefore, every effort should be made to take the student past a definition which incorporates only the individual (and his/her immediate surroundings) and only living things.

Later in this module, in **Exercise I-4**, the students are asked to generate a definition for "environment" on which the class can agree - a definition of environment which might serve as a model throughout the entire modular program. One example of such a definition might be: **The environment is made up of all the objects and events in the universe (both living and non-living), plus all of the interactions taking place between those objects and events.**

Exercise I-2 (pp. 4-8) involves the students in describing and analyzing the effects of their actions on the environment. The materials on page 4 have described several of the

interactions between the students and the environment which are associated with the preparation of a simple piece of breakfast toast. The diagram on pages 6 and 7 traces those interactions from the wheat field to the toaster. The teacher may wish to ask students to examine each step in the diagram and to discuss the resource use and environmental impacts related to each step. The 12-minute film, **Toast**, also presents the energy intensive processes used in food production and distribution. This visual is available for purchase or rental in both 16 mm and videotape formats from Bullfrog Films, Oley, PA, 19547 (Tel. 215-779-8226).

On page 5, the students are presented with a table which summarizes several of the steps involved in producing toast, and the related natural resource use. A series of tasks follow that summary:

Task 1. Identify the possible environmental effects of using soil, petroleum, natural gas, and coal. Some of these effects include the depletion of soil nutrients, possible loss of topsoil through erosion, acidic runoff from abandoned or neglected strip mines, depletion of the limited supply of fossil fuel reserves, depletion of petroleum reserves used to manufacture pesticides and fertilizers, damage to marine life due to oil spills, air pollution, acid rain damage from high sulfur coal-fired power plants, tundra degradation by oil pipelines, etc.

Task 2. Decide on the importance of these effects. The importance of these possible effects must not be underestimated. If students have difficulty with this task, the instructor may wish to point out several of the following ideas:

1. A finite supply of energy resources is being depleted. Is this energy utilized to supply human needs or to fulfill human desires for convenience?

2. Irresponsible human use of energy resources can often lead to polluting other natural resources, such as air, soil, and water.

3. Irresponsible human use of energy resources may damage natural ecosystems (e.g., damage to fragile Arctic ecosystems from oil pipelines, damage to oxygen-producing marine plankton due to oil spills).

Task 3. Defend the idea that human benefit and resource use is a two-way street. This task requires the students to think about the balance between human resource use and human benefit (the balance between the quality of life and the quality of the environment). Student responses will vary. It is hoped that the student will begin to realize that, in general, humans take a consumptive or utilitarian (user-oriented) view of the natural environment, rather than a perspective of husbandry or stewardship of the planet. Humans tend to take from the environment that which they want, in addition to that which they need. Our indiscriminate use of the natural environment carries with it severe impacts (some irreversible) on our life support system. In turn, if and when, humans return "resources" to the environment, they are often in the form of solid or liquid wastes, some of which are non-reusable since they do not readily decompose or

chemically disintegrate and, therefore, cannot enter the natural material cycles of the ecosystem (i.e.., the biogeochemical cycles). In some cases, these wastes are toxic to humans and to natural ecosystems as well.

Exercise I-3 (p. 9) further extends the idea of the balance between the quality of human life and environmental quality. It is hoped that this task will help students to understand that the fate of the human species is closely interrelated with the fate of the environment. Middle and junior high school students are quite capable of intellectually handling the idea of ethical responsibilities to future generations. A teacher-posed question, such as "Is it all right for humans to take whatever they want in order to have a good life . . . or should they think of those who come after them?" can evoke varied responses and precipitate a valuable class discussion.

If the students do not generate the idea of a link between environmental quality and human health, the teacher may want to discuss the growing numbers of illnesses and diseases which may be linked to air and water pollution, toxic wastes, asbestos use, etc. In these cases, human health appears to be very directly related to environmental quality.

Some students may also identify the personal, psychological, and aesthetic benefits which humans derive from spending time in pristine or relatively unchanged natural environments. Although it is impossible to put a price on this benefit, its value to the human spirit is immense. If resource use threatens the survival of such natural areas, it might also be regarded as a threat to human well-being.

Exercise I-4 (p. 10) Here, the students are asked to generate a definition for "environment" on which the class can agree - a definition of environment which might serves as a model throughout the entire modular program. One example of such a definition might be: **The environment is made up of all the objects and events in the universe (both living and non-living), plus all of the interactions taking place between those objects and events.**

Exercise 5 (p. 11) asks the students to list four environmental problems. This number should not prove too difficult for students. However, the instructor should monitor the manner in which environmental problems are communicated, taking care that **the statement of the problem also includes the problem source**, e.g., not simply "soil erosion", but rather "soil erosion . . . due to poor farming practices", or " . . . due to overgrazing of pasture land", or " . . .due to deforestation ". It is important that the environmental problem be described completely so that the it is precisely identified and can be distinguished from all other environmental problems. This precise identification will be helpful in further analysis and research on the problem.

Exercise I-6 (pp. 12-14) requires the students to consider the sequence leading from a natural event to an issue and to its resolution. This exercise utilizes the information on Mount

St. Helens presented on the previous pages, and uses the Mount St. Helens volcanic eruption (and the problems and issues which developed from this event) as an example of the relationship between events, problems, and issues. Limited information about the Mount St. Helens eruption is presented in the student manual. Additional information can be found in the January, 1981 issue of **National Geographic** (Vol. 159, #1).

In the exercise, the students are asked to apply the sequence starting with the eruption of Mount St. Helens as the event. A number of problems and issues have resulted from this event and, therefore, a number of sequences are possible. The sequence which follows focuses on the fallen timber problem.

Problem - Issue Sequence

Event	Eruption of Mount St. Helens
Environmental problem	Acres of timber flattened by the blast from the eruption.
Issue	What should be done with fallen timber?
Possible solutions	1) Remove timber for processing & sale. 2) Allow timber to remain on the ground.
Resolution of issue	Unresolved . . . will depend on which values are chosen and acted on.

Students may suggest other problems and issues which resulted from the eruption of Mount St. Helens. The instructor should accept as correct those sequences which students can defend as valid environmental problems and issues.

Photo Essay (pp. 15-22). The photographs used in this section of Module I depict a number of environmental problems and issues. Almost every photo caption contains pertinent questions, which may require further research on the part of the students in order to obtain answers. In addition, almost all captions supply excellent discussion material. Do not feel limited to only those questions which are presented. Students will probably generate others as the essay items are discussed. A helpful expansion of this photo essay would be to supply (or have students bring in) other visuals collected from magazines, newspapers, etc. for further discussion. It might also be beneficial to establish a photo file and/or bulletin board in the classroom as an ongoing reservoir of reference materials.

The section entitled **Beliefs and Values (pp. 23-24)** introduces students to the roles of human beliefs and values in environmental issues. The instructor is urged to refer back to related materials in the teachers edition (TE) so that he/she can effectively interact with students when dealing with beliefs and values. Pages 9-10, TE, present a brief overview of what is known about beliefs and values and their relationship to environmental issues and environmental action. The

section also deals with the teaching of beliefs and values. A second section, located on pages 16-17, TE, discusses teaching strategies for examining and clarifying values. It is tremendously important that, regardless of which values clarification strategies the teacher may choose to use, a **value fair** atmosphere must be established in the classroom. Such an environment enables students to feel comfortable expressing their own beliefs and values and demands that they respect the rights of others to do the same.

Exercise I-7 (pp. 24-26) is designed to permit students to examine their beliefs and values about specific environmental issues, and to compare their own with those of their classmates. This activity should enable the students to understand that there is often disagreement regarding beliefs and values. This may well be one of the more crucial tasks in Module I. It is crucial because it is very necessary for students to begin perceiving what a human value is, and to understand that human values regarding a specific topic differ. It is also important that students do not end this activity with the idea that value positions are either right or wrong. Rather, students should be encouraged to examine the ecological implications (or consequences) of the values which they express. An excellent example of this is related to Statement # 2. Large families may very well be socially desirable, but they are also probably ecologically harmful, given what is known about population dynamics.

The correct concept for the student to have at the close of this activity is that **differing values may exist regarding a problem, and that because of this environmental issues exist**. Further, it is important to help students conceptualize that values can often be expressed along a continuum from one extreme position to another extreme position. They should also realize that the "neutral" position is often taken because of a lack of information regarding an issue rather than as a lack of commitment to a particular value stance.

Exercises I-8 and **I-9** involve students in analyzing environmental issues in terms of the **players, positions, beliefs and values** which exist regarding those issues. Students may experience difficulty in labeling specific values which are reflected in the issues. In order to assist the students in this task, it will be helpful to discuss the differing values with them.

In **Exercise I-8 (pp. 27-28)** the student is asked to identify the beliefs held by both the lumber companies and the Protective Association. It is important for the students to understand that they should be able to cite evidence from the written account which supports their answers. After information pertinent to this analysis is presented in the prose, a sample issue analysis chart is presented. Although students may at first have difficulty identifying beliefs and values, every effort should be made to bring them to criterion on this. It is important for the students to realize that differing beliefs and values are at the basis of every environmental issue and often complicate its resolution. Also, students should understand that unless one becomes aware of the beliefs and values involved in a particular issue, one will not be able to understand that issue.

Issue analysis, then, is an important skill, since it assists in organizing information and leads to a better understanding of a particular issue.

A chart of value descriptors is provided on p. 29. These descriptors are meant to serve as guides in making decisions related to issue analysis.

In **Exercise I-9 (p 30-31)**, the student is asked to analyze an issue associated with the plans for reclaiming a stripmined area. In this activity, the student must identify the different positions taken by each the players in the issue. Students must also identify the beliefs and values underlying each of these positions. A sample analysis chart related to this issue is presented below.

A Sample Issue Analysis Chart

Issue: Should 483 acres of land to be strip-mined in Perry County be reclaimed for agricultural productivity or converted to state-owned wetlands habitat?

Player/Position	Beliefs	Values
Leonard Heisner - Chair, Perry Co. Board: Reclaim as farmland (Inferred position)	Too much farmland has been lost due to economic dependency on coal mining.	Economic
Perry County Farmers: Reclaim as farmland	Geese are eating crops and increasing weed populations.	Economic
Randy Zetter - Former SWCD Chair: Reclaim as farmland	Weed control costs will be high.	Economic
Representatives of sportsmen, state agency, and wildlife researchers: Reclaim as wetlands	Additional wildlife acreage will help counterbalance the loss of wetlands.	Ecological
Fred Kirkpatrick - Illinois Sportsmen Legislative Coalition: Reclaim as wetlands	Farmers could make money from operating goose hunting pits; geese will save many family farms.	Economic
James Moak - Illinois Department of Conservation: Reclaim as wetlands	Recreation area will be increased; Use of area will generate $1.2 million.	Recreation and Economic
Parent "A": Reclaim as farmland	Schools will lose property tax.	Economic
Parent "B": Reclaim as wetlands	Family hunting trip is as educational as a book.	Educational

Exercise I-10 (p.33) asks students to apply Issue Analysis to an environmental issue of their choosing. It is highly recommended that you reproduce the Issue Analysis Worksheet, from page 31 in the student text, and use it to provide additional practice for your students in Issue analysis.

In **Exercise I-11 (p. 33)** students are asked to once again look at the four environmental problems which they named on page 11, and to decide whether those environmental **problems** are also environmental **issues**. The instructor may prefer to postpone discussion of this exercise until students have completed **both** Exercises I-10 and I-11.

Exercise I-12 (pp. 33-34) requires students to **restate two issues** of their own choosing and to **explain why they are issues.** The activity gives them an opportunity to test their abilities in explaining why a certain issue exists. Students typically have little difficulty in identifying an issue, but they may have some trouble in explaining why it is an issue. The instructor should patiently guide the students to criterion on this task. The prose on page 34 presents the two major criteria to be used when determining whether the student's explanation of why the issues named are environmental issues. Those criteria are:

1. Did the student's chosen issue include evidence of man, the environment, and interactions between the two?
2. Were conflicting beliefs and values evident in the student's explanation of why he/she considered this an issue?.

If it appears that students are frustrated by this activity, it is suggested that the instructor discuss one or more environmental issues with the students, emphasizing those factors that do, in fact, make them issues. These might be recorded on the chalkboard as models for future reference. Further, the instructor might wish to assign two or three additional issues as a homework assignment.

Exercise I-13 (p. 34) summarizes the essence of Module I by asking the student to define the term, "environmental issue". Although the definition of this term is not an easy task, it seems important to make the students to come grips with an accurate and workable definition at this point in the modules. Environmental issues, by their very nature, involve humans. And, as has been stressed, human values and beliefs play a significant role in the creation of environmental issues and in their solutions. Therefore, an eventual definition produced by the class working cooperatively might be: **Environmental Issue: A particular interaction between man and his environment about which there are differing beliefs and values.**

GETTING STARTED ON ISSUE INVESTIGATION

MODULE II

Overview

In Module II, students are first given a set of experiences in classifying environmental issues as local, regional, national or international and in defending the classification scheme they created. They are then introduced to first hand and secondary sources of information and classify issues in terms of the type of investigation (primary or secondary) which will produce the best information on those issues. Subsequently, students develop logical and pertinent research questions regarding environmental issues based on an analysis of secondary source information.

Students are also introduced to periodicals, agencies, and examples of community resource people which are valuable in obtaining information concerning environmental issues. Students compare secondary sources to identify how they differ from each other, identify governmental or private agencies to which they can write for information, write letters requesting information, identify and communicate two or more value positions expressed in environmental news articles, write a succinct summary of an environmentally related article, and locate three valid references for an environmental problem of their choosing. Further, they are introduced to the skills needed for the successful use of the library, i.e., the card catalog, the Reader's Guide, the Dewey Decimal System, and cross indexing. Finally, students are presented with a written research report which serves as a model and are asked to analyze that report. (Specific objectives for Module II can be found on pages 36-37 of the student text.)

Suggestions for Teaching Module II

Module II introduces the student to an array of strategies he/she will find extremely useful in researching environmental issues using secondary sources. Locating, analyzing, and using information sources are the key elements in this module. At first glance, most of the objectives deal rather specifically with language arts skills. Even though this module emphasizes language arts skills, these processes are developed entirely around environmental topics. Thus, one of the more prominent challenges of education is met squarely in this module - the integration of content. Aside from this highly desirable aspect of Module II, students are again exposed to a wide array of environmental issues, ranging from energy production to polar bear management. A good deal of conceptual content is subtly infused into the module making it attractive for teaching environmental education.

Module II begins with a suggested activity - an **issue collection**. The authors have found that most students do not have a working knowledge of a number of environmental issues. Many science classrooms and school libraries do not have extensive collections of environmental issue information. A partial solution to both of these problems is to ask students individually to collect environmental issue information which then could be made available for classmates. This **pool of environmental issue information** becomes a resource for future assignments within this worktext, particularly the issue investigation in Module V.

Exercises II-1 and **II-2 (pp. 41-42)** engage the students in tasks requiring the skill of classification and the defense of classification schemes for environmental issues. Classification is man's way of organizing information into useful packets. It is arbitrary and, although this process follows particular rules for particular subject matter, it is simply a means for grouping objects and/or events having similar properties.

In **Exercise II-1 (p. 41) issues are identified and classified as being local, regional, national, or international** in importance. In **Exercise II-2 (pp. 41-42)** this same classification is repeated but more extensively since students must use various information sources and generate several issues under each classification. It is important for the instructor to stress that the issues be stated very specifically and communicated very clearly. It might be valuable to construct a total listing for the entire class. This list could be saved for Module V and used as a pool (idea bank) of issue topics for issue investigation.

Exercise II-3 (p. 43) asks students to determine whether issues can be investigated using **first hand (primary) sources, secondary sources, or a combination of sources** by reclassifying the fifteen issues identified in Exercise II-2 accordingly. This final classification task is a most pragmatic one in that it is a prerequisite to subsequent tasks in Module II.

Exercises II- 4 and **II-5 (pp. 47-52)** concern the analysis of historic situations involving environmental issues for the purpose of writing **research questions**. The purpose of this module is to provide students with the skills needed to start issue investigations. The writing of research questions is one of these critical skills because research questions provide a focus or direction for the investigation. This focus is the basis on which many subsequent investigation decisions are based.

There are undoubtedly many ways to train students to write research questions. The authors have used the following strategy: **1) an analysis of an environmental situation to determine the issues they contain, 2) the identification of key variables (i.e., factors and/or conditions) contained within each issue, and 3) the writing of research questions based on the identified variables.** This strategy was used with two historic situations dealing with wildlife.

In **Exercise II-4 (pp. 47-50)**, which deals with Pennsylvania deer, the students are provided with examples at each step, i.e., identifying the issues, identifying the variables within the issue, and writing research questions with the variables. These **examples model each step** for the student. At this point **rules for writing research questions** are introduced to the student.

Students are then asked to use the three-step process independently in a second situation which deals with whooping cranes. In **Exercise II-5 (pp. 50-52)**, the students are asked to **identify key variables** involved in the whooping crane issues. Using the research question rules, students then **write appropriate research questions** which incorporate the identified variables. The following variables could be identified from an analysis of the whooping crane information:

1. the size of the Bosque del Apache whooping crane population
2. lead shot poisoning
3. goose hunting on the Bosque del Apache Refuge
4. whooping crane reproduction (pair bonding)

Other variables could also be inferred: refuge hunters' attitudes about refuge hunting, refuge hunters' skill at crane identification, and the amount of lead shot accumulation in the refuge environment. The following research questions are examples of appropriate research questions using the variables identified above:

1. To what extent does lead shot poisoning contribute to a decline of the whooping crane in the Bosque del Apache Wildlife Refuge?

2. To what extent would refuge hunters agree with a ban on hunting on part or all of the Bosque del Apache Wildlife Refuge?

3. How much lead shot has accumulated in both the Bosque del Apache ecosystem and the adjacent areas?

4. What evidence is there, if any, that indicates that lead shot poisoning is affecting waterfowl species other than whooping cranes both in the Bosque del Apache Refuge and in adjacent areas?

The instructor may wish to personally critique/evaluate students' research questions or to conduct a peer evaluation session. Regardless of the method which is chosen, the **research questions should be critiqued in light of the rules for research questions.** It is often profitable to have students self-critique their research questions and defend them against those rules.

Care should be taken to insure that a logical reason exists for posing a particular research question. Consider, for example, the following research question: To what extent does lead shot poisoning affect whooping crane pair bonding on the Bosque del Apache Wildlife refuge? Based on the information presented, this is an invalid research question because there was no evidence presented or implied which related the variable lead shot poisoning with the variable, whooping crane pair bonding. The point is this: **research questions should deal with variables or relationships between variables which were directly stated or implied in the secondary source information.**

In **Exercise II-6 (p. 52)** the students are provided with three research questions and informed that these research questions might be flawed. The **students are asked to evaluate these research questions**, i.e., compare them against the rules for writing research questions. Research Question One (1) is weak because it can be answered with a "yes" or "no" response. It does not contain a population or area. The term "problem" is vague and needs to be operationalized by the substitution of a specific variable. Research Question Two (2) does not contain a population or area. Research Question Three (3) meets all the criteria of an appropriate research question.

Writing research questions is a skill critical to successful issue investigation. It is important that every effort be made to bring students to criterion on this task. It might be necessary for the instructor to use a new issue narrative, one of his/her own choosing, in order to provide addition training for students.

Pages 54-56 of Module II provide a brief **list of organizations and agencies** concerned with aspects of the environment. At some point students might need additional addresses. Perhaps the best listing of organizations, agencies, and individuals concerned with natural resource use and management is the **Conservation Directory**, published yearly by the National Wildlife Federation. The cost of the 1992 **Conservation Directory** is $18, plus $2.50 for shipping. It can only be purchased from the National Wildlife Federation, 1400 Sixteenth Street, N.W., Washington, D.C. 20036-2266.

Exercise II-7 (pp. 57-63) focuses on getting the student to realize that he or she must approach references dealing with environmental issues cautiously. The fact that many references deal with very specific **biases** makes this activity extremely important for the student. Just what should a person believe? What biases are present? Why is the author biased in the manner reflected in the article, pamphlet, etc.? How can a person check the validity of the information given? These are all points to consider in dealing with information and tasks associated with II-7.

Pages 57-61 present two articles on the same topic - the plight of the African elephant. However, these two articles offer two very different solutions to this issue. The articles also reflect different value perspectives. In Exercise II-7, students are asked to state the main points made by each author, and to identify the underlying value in each article. Both articles might be termed "pro-elephant". Similarly, both articles link the plight of the elephant to the ivory trade and, more specifically, to the demand for ivory on the world market. In the Brooks article, the solution reflects legal values . . . stepped-up enforcement against poaching and a trade agreement which bans the sale of all ivory. The West article, on the other hand, reflects an economic value . . . structuring a situation in which the elephant becomes an economic benefit (conservation by utilization).

This activity not only reinforces the students' perspectives of values but it also gets them ready to begin reading and summarizing articles concerning environmental issues. It is hoped that the student has begun to perceive the necessity for reading critically, particularly in a context of bias or values. This activity bears repeating if you have available divergent articles on the same issues. Perhaps there is a local or regional environmental issue occurring in your area which is being covered in the local papers and which can be used in a values analysis activity.

Exercise II-8 (pp. 63-64) involves the student in the short but important task of determining **where to write for information** concerning 1) loss of North American wetlands and 2) values which contribute to the growth of the human population. Appropriate responses for the first part of II-8 include might include the National Wildlife Federation, the National Audubon Society, the Sierra Club, the Izaak Walton League, and the Soil Conservation Society. Responses for the second task include Planned Parenthood and Zero Population Growth. The written activity, although important, is probably far less important than the rules expressed for letter writing activities in the next section.

Exercise II-9 (p. 64) requires the student to **write a practice letter which requests information on an environmental topic**. The instructor is encouraged to reinforce the rules stated in this module concerning the writing of letters for information. Summarized, they can be listed as follows:

1. Choose an appropriate source to which to write.
2. Be very specific in the request for information.
3. Use proper form, grammar and punctuation.
4. Whenever possible, address the request to a specific individual.

This exercise gives the instructor an opportunity to **evaluate the students' letters**. It is highly recommended that the teacher be rigorous in his/her evaluation of these practice letters. A poor model at this time will not guarantee good letter-writing skills when applied in a real situation. Your students may require specific instruction in letter writing. Do not hesitate to provide that instruction, or to team with the language arts teacher in order to help your students develop good letter writing skills.

Although no activity is suggested for **interviewing local resource people (p. 65)**, feel free to create your own. The students might be assigned a specific topic and instructed to name two or three pertinent resource people. A role-playing situation between interviewer and interviewee would also seem an appropriate extension. The class might then critique the session in terms of appropriate interview procedures. Telephone protocol might be another discussion/ activity topic.

Exercise II-10 (pp. 66-69) has the **student write a summary of an article** approved by the instructor. This task gives the student practice in summarizing a printed article and forces him/her to take a hard look at his/her summary from several standpoints. It is somewhat questionable whether this one summarizing assignment will give the student expertise in this skill (or set of skills). The instructor may well decide to have students summarize an additional article. Some teachers have reported success by 1) having students summarize the same article, 2) collecting and evaluating those practice summaries, 3) providing students with a model summary of the article, and then 4) having students revise their first drafts based on the teacher evaluation and on the model presented.

Library Research **Exercise II-11 (pp. 70-71)** finds the student searching for three

references concerning a particular topic and arranging them into a **standard bibliographic format**. Some educators would question doing this exercise before giving the students an introduction to library skills. However, the task is placed here for a reason. It is hoped that the student will experience at least a minimum of frustration in the completion of this assignment. Although not a strategy used often enough in the classroom, students learn much better when they perceive the need. Subsequently, library skills should be developed better as a function of some frustration with Exercise II-11. However, the task in Exercise II-11 is an important one in its own right and should be completed. It is further recommended that Exercise II-11 be repeated at the end of Module II as an evaluation of the extent to which students have acquired library skills.

Pages 71-73 introduce the student to the **card catalog**. The three main types of cards found in the card catalog and the information found on these cards are identified. The Dewey Decimal System is also outlined. **A trip to the library and actual contact with the card catalog is crucial.** Topics should be assigned students to look for after the card catalog is reviewed in the library itself. A few possible topics follow:

Subjects

air (air pollution)
Alaska
bison (buffalo)
coal mining
conservation
ecology
energy
mammals
national parks
noise (noise pollution)
nuclear (nuclear energy)
pesticides
population
prairie
river
soil
swamps
waste (waste disposal)
water (water pollution)
wolf (wolves)

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Steward L. Udall
Willy Ley
Garrett Hardin
Rene Dubos
Paul R. Ehrlich
Lester Brown

If your school library is inadequate, a field trip to the high school or public library is highly recommended.

Exercise II-12 (pp. 73-74) calls for the student to recognize an author card, state where in this library this particular card will be found, and identify the specific information found on an author card. If the student achieves criterion on this task, one might feel confident about the student's understanding of catalog cards.

Pages 74-76 approach the topic of **The Reader's Guide** in much the same manner as the card catalog. The publication is explained and specific examples with their associated symbols are provided. Cross indexing and its value are introduced. This section closes with **Exercise II-13 (p. 76)**, which calls for the student to identify the information and symbols used in a specific reference from The Reader's Guide.

Again, **it is strongly recommended that The Reader's Guide be studied in the library itself**. It is a tremendously valuable tool in doing library research and the student who does not feel comfortable with it could wander aimlessly, accomplishing little. It is further recommended that topics be given the students for practice in using The Reader's Guide. The instructor may wish to evaluate the students in more detail than Exercise II-13. This should be considered appropriate, particularly if students do not achieve criterion on Exercise II-13.

Pages 76-81, present a research report entitled "The Polar Bear: An Endangered Species?". This research report is presented as **one example of the type of product made possible by using secondary sources.** It should be pointed out to students that this research report did not use primary data. Therefore, it might not represent a model of the issue investigation assignment in Module V (depending on the data sources, i.e., primary, secondary, or both, that the instructor elects as criteria).

Exercise II-14 (p. 82) requires the student to **analyze the polar bear research report.** The topic of the polar bear is one having considerable interest for middle school students so motivation for reading is little problem. However, Exercise II-14 asks some pointed questions about the report which may demand that the student go back and do some critical reading. Appropriate responses for Exercise II-14 follow.

1. American Museum of National History
   National Wildlife Association.

2. The particular question referred to by the student cannot be answered simply because no one knows for sure at this time.

3. The author's values concerning polar bear management are largely inferred from the title and the first and last paragraphs of the reports. (It is suggested that, during class discussion of this particular assignment, students attempt to interpret what the author's values are. Further, the instructor can theoretically place the author in fictional situations and ask the class how he/she would probably behave in those situations, e.g., the writer is invited to go to Labrador and hunt polar bears for their skins).

4. There is no right or wrong answer here as it depends upon the reader's perceptions concerning the quality of the work. However, it is important for students to adequately defend their positions, whichever way they choose to respond.

Again, the authors of this module suggest repeating Exercise II-11 at this time unless students appear to have a thorough grasp of how to use the library. If repeated, students should probably research a topic different from that researched the first time Exercise II-11 was completed.

MODULE III

USING SURVEYS, QUESTIONNAIRES, AND OPINIONNAIRES IN ENVIRONMENTAL INVESTIGATIONS

Overview

In Module III, students are introduced to the basic research strategies reflected in its title. They identify several environmental topics which lend themselves to gathering data using surveys, using questionnaires, and using opinionnaires. Models of each of these techniques are presented, along with appropriate data summary sheets, and students are asked to identify and compare the characteristics of each model. Working from a list of ten research questions, students then identify which of the three techniques is most appropriate for use in answering each of the questions. A subsequent section familiarizes the students with ideas associated with sampling (population, sample, representativeness, random sampling, samples of convenience, interviews), and with data collection techniques. Finally, working closely with the instructor, students identify research questions of interest to them, design surveys, questionnaires, or opinionnaires with which they might be able to answer those research questions, collect data using their instruments, and record those data on summary tables. (Specific objectives for Module III can be found on page 84 of the student text.)

Suggestions for Teaching Module III

Module III introduces a variety of strategies which students will find useful for collecting data on a first hand basis (i.e., from primary sources). Additional instruction on sampling and its function in research is provided, and students are then asked to apply what they have learned in designing and carrying out a survey, questionnaire, or opinionnaire.

Exercise III-1 (p. 85) focuses on the parameters of **surveys** and the kinds of questions and/or problems for which surveys can provide useful data. Following this, students are asked to list two good survey topics. If the students do, in fact, incorporate most of the major conditions critical to surveys in their responses, the instructor can assume that adequate conceptualization has occurred. However, if the responses of some students are inappropriate, the instructor should provide them with additional time, help, and practice in correctly identifying survey topics. Following Exercise III-1, the students are presented with a **model survey** containing the survey (research) questions, procedures, data grid, and a summary analysis sheet. The students should examine those items carefully, and identify the survey characteristics of the model.

Exercise III-2 (p. 89) familiarizes the students with the parameters of **questionnaires** and with the kinds of questions and/or problems for which questionnaires can provide useful information. Again, the instructor is urged to observe the students' competence in suggesting appropriate topics for questionnaires as an indicator of whether they conceptualize what a questionnaire is and when it should be used. As with the survey, the students are presented with a model questionnaire and its data summary sheet. Again, it would be helpful for the students to examine and discuss the model and why it represents a good questionnaire. An excellent teacher reference on questionnaires is **Questionnaires: Design and Use**, by D. R. Berdie and J. F. Anderson, available from The Scarecrow Press, Inc., Metuchun, New Jersey 08840.

The following section introduces students to the **opinionnaire.** Although survey instruments often include a mix of both questionnaire and opinionnaire items, it is important that students are able to differentiate between the two. **Questionnaires are designed to collect hard, cold facts, or data. Opinionnaires are designed to describe the thoughts of a group of individuals about a specific topic at a specific time or to describe the feelings of individuals on a specific question or topic.**

Exercise III-3 (p. 92) asks the students to write specific questions and/or problems for which an opinionnaire can be used to collect information. The use of the question format for the responses is recommended. This task gives students practice in setting parameters for opinionnaires which will ensure the collection of meaningful data. As before, student performance on this task can be viewed as an indicator of whether or not conceptualization has occurred. A **model opinionnaire** on littering (along with a data summary sheet) follows.

In Module III, the students are familiarized with the characteristics of surveys, questionnaires, and opinionnaires, but few formal rules for their development are provided. The instructor may wish to have the class discuss the differences between the three techniques and to establish rules to follow when conducting each of these techniques. A class discussion or small group activity can be useful in generating the three sets of rules. Since the rules will probably influence the quality of the products which students generate, the experience should prove to be quite valuable from a learning standpoint and worthy of the time it takes to accomplish. The rules for surveys, questionnaires, and opinionnaires are on the following page.

Rules Governing Surveys, Questionnaires, and Opinionnaires

S = Survey **Q = Questionnaire** **O = Opinionnaire**

S	Q	O		Rules
X	X	X	1.	Carefully decide the exact information (data) to be collected.
X	X	X	2.	Specify the exact geographic area in which the data are to be collected.
	X	X	3.	Specify the exact population from which the data are to be collected.
		X	4.	Specify the exact opinions and/or beliefs about which the data are to be collected.
X	X	X	5.	Collect enough data to make sure that the data are truly representative of the question under investigation.
X	X	X	6.	Record all data carefully and completely.
X	X	X	7.	Work out a system that will accurately communicate the data to others, e.g., charts, graphs, tables, written discussion.
X	X	X	8.	Make sure that all conclusions, inferences, and recommendations are substantiated by the information collected (See Module IV).

Exercise III-4 (p.96) is a **self-test** designed to help the students determine whether or not he/she fully understands the distinct differences between surveys, questionnaires, and opinionnaires. If a student responds correctly to all ten items on the self-test, the instructor can infer that the student has a good grasp of the information presented in the previous exercises. Students should be encouraged to correct any errors by applying the rules governing surveys, questionnaires, and opinionnaires to the statement in question.

The next section of Module III focuses on the individuals who respond to questionnaires and opinionnaires, and on how we contact those individuals. A number of important ideas are presented to the students here. In order to obtain unbiased information, it is critical that each viewpoint within a population has an equal chance of being represented in the collected data. If the population is small enough (e.g., the service station owners in a small town), this presents no problem. We simply contact each member of the population. However, many investigations will necessitate obtaining data from larger populations (e.g., all registered voters within a county). In these cases, it may be impossible to survey every member of the population and the researcher

will have to be content with surveying a **portion** of that population (i.e., **a sample of the population**).

How large should the sample be? That is a tricky question. The answer, of course, is "large enough to give you a sample which represents the viewpoints contained within the entire population. And so, again you ask, how large should the sample be? A great deal depends on how diverse the population is. If members in your targeted population are very similar in background, occupation, age, education, political affiliation, religious beliefs, etc., you may be able to obtain valid (and representative) results using a small percentage of them. However, if your population is varied, a larger percentage should be sampled, in order to ensure that as many views as possible are represented.

The example on Mill County might prove helpful, here. In order to get a sample size of 70, a seven percent (7%) sample was selected. This simply means that 7% of the households in Mill County were included in the sample. Of course, we are assuming that all seventy households which were surveyed responded to the survey. If not, additional households would have to be selected until the sample consisted of a total of seventy.

Four ways of obtaining the sample are describe in the student text. In the first method, **random sampling,** all households in the county had an equal chance of being chosen to participate. Therefore, the probabilities are good that all viewpoints within the population (all households) would be represented in the sample.

In the Mill County example, it is possible that an individual's viewpoint on the proposed landfill might be influenced by his/her proximity to the proposed landfill site. Therefore, a second method of sampling is described. In this method, the population is divided into groups, and individuals are randomly chosen from each of the groups. Here, those groups were based on location, but they could also be based on age, or gender, or political affiliation, or whatever variable seems appropriate. This is also a 7% sample, since 7% of the households in each location were selected for the survey. The second methods gives us a **stratified random sample.**

A third method of sampling is the **systematic sample**. An example of this would be the selection of the 23rd (or 16th, . . . or 42nd, . . . etc.) name from each page of a telephone book (or from a list of voters, or from a membership list, etc). Although not as desirable as a true random sample (methods 1 and 2), a systematic sample is still highly preferable to still another type of sample, the sample of convenience.

The **sample of convenience** is the poorest method of sampling, and quite often results in invalid and biased results. There is simply little probability that the people you happen to encounter at the supermarket on Saturday morning (or those who go to the same church you do, or those who belong to a particular lodge, etc.) will reflect the viewpoints of the entire population. That is, of course, unless your population is made up of Saturday morning shoppers (or the membership of a particular church, etc.). **Students should be strongly encouraged to use one of the other, more valid, methods of sampling, if their data are to be taken seriously.**

The process of **interviewing** is not given much space in this chapter. Yet, the strategies associated with interviewing are very important. There is no doubt that some of your students will be using the interview for at least part of their research. In all interviewing instances, you will want the students to write out the questions that they will use in the interview. In this way you can check the proposed strategy to determine if the questions are on target and to make sure that the interview will not be too long. Sometimes a balance between thoroughness and simplicity is hard to find but it's important for the student researcher to search for this combination.

Exercise III-5 (pp. 103-104) gives the student an opportunity identify a local environmental issue of interest to him/her, and to formulate research questions appropriate to the issue. The instructor should help students to check their research questions against the criteria for research questions described in Module II, and against the rules which govern surveys, questionnaires, and opinionnaires.

Exercise III-6 (pp. 104-107), exists as the culminating activity of Module III, and can be approached in several ways. In the activity, students are to plan and conduct an actual survey, questionnaire, or opinionnaire. The instructor may decide to use one of the models presented in Module III, or to allow students to select an entirely different issue to investigate. In either case, the planning sequence should be carefully followed once a decision has been made about the issue to be investigated. The sequence is recommended since it brings an analytical approach to this aspect of the issue investigation, and serves to bring together in an applied setting those skills which were developed in Modules I, II, and III. It will also assist the student when he/she undertakes autonomous research in Module V.

When setting up Exercise III-6, the instructor may want to consider the following suggestions:

1. Divide the class into research teams, with each team responsible for a survey, questionnaire, or opinionnaire on their chosen topic. It is usually preferable not to assign more than four students to a team.

2. The instructor may choose to allow each team to decide whether it will conduct a survey, questionnaire, or opinionnaire. An alternative is to assign the type of research instrument which each team is to utilize. The chosen issue will, in many instances, dictate which of the instruments will be used. **It is imperative that at least one survey, one questionnaire, and one opinionnaire is used in this assignment.**

3. Assist students in carrying out their surveys, questionnaires, and opinionnaires.

4. Using data sheets, ask each team to share its findings with the rest of the class. This might be accomplished in several ways: short, informal oral reporting; duplication of data sheets; written discussion of the data. Class discussion and analysis of the surveys should follow.

[**Note:** Module IV will introduce the students to data interpretation. Several teachers have reported considerable success when they began Module IV while students were still collecting and compiling data from their Module III assignment. Following the completion of Module IV, students were asked to apply what they had learned and to interpret the data from **their own** survey, questionnaire, or opinionnaire.]

MODULE IV

INTERPRETING DATA FROM INVESTIGATIONS

Overview

In Module IV, students are introduced to techniques of communicating and interpreting data. Students are initially provided with models of logical conclusions, inferences, and recommendations, and then are given practice in identifying and writing conclusions, inferences, and recommendations. Similarly, students are introduced to descriptive and graphic methods of reporting data, to generating conclusions and inferences from descriptive and graphic data, and to discussing the advantages of each method. After transferring a set of descriptive data to graphic form, students are asked to formulate logical conclusions, inferences, and recommendations based on the data, and to revise those recommendations when additional data are provided. Finally, students apply the skills of concluding, inferring, and recommending to two different data sets, one regarding coyote control, and one regarding opinions on littering. (Specific objectives for Module IV can be found on page 110 of the student text.)

Suggestions for Teaching Module IV

In Module IV, the students are introduced to methods of communicating and interpreting data. In order for data collected by an investigator to be meaningful, he/she must be able to report that information to other investigators and interested individuals. The investigator should report the data as simply as possible in a concise, logical, and orderly sequence. Furthermore, it is the investigator's responsibility to provide, on the basis of the data, an interpretation of the data collected, e.g., accurate conclusions, logical inferences, and sound recommendations.

The authors have found that students understand the importance of clear, concise communication better if one basic rule is followed: **All scientific writing should be completed in such a manner that someone completely unfamiliar with it can understand it.**

Exercises IV-1 and IV-2 (pp. 111 - 113) focus on conclusions and inferences and discuss how these two processes differ. It is important that the students understand what constitutes a good conclusion and a good inference. During these exercises, the teacher and students must keep firmly in mind that **a conclusion simply states the end result. It is the communication of an observable event, happening, and/or situation. Conclusions precisely follow the observations made and in no way attempt to explain why something happened as it did.** An

inference, on the other hand, is related to a conclusion, but is completely different. **An inference is the explanation of an observation (or a conclusion). It is an implication - an assumption or judgment made from the data.**

The instructor may wish to present several situations to the students for additional practice with concluding and inferring. Two such situations are provided below and may be presented to the students either verbally or in written form. It is suggested that the students be asked to generate one conclusion and one inference based on the information presented in each situation. The students should also be asked to defend their responses in accordance with the guidelines for formulating good conclusions and inferences.

Situation #1

A botanist visits a woods every ten years to study a population of wild, rare orchids. Each visit he observes that the population gets smaller. The conditions in which the orchids are growing seem to change very little. Although he sees no people there on his trips, he does note increasing evidence of camping in the woods.

Suggested Responses:

Conclusions: The orchid population is decreasing.
Environmental conditions appear to be stable.
Evidence of camping activity is increasing.

Inference: Campers are probably digging up orchids and taking them home.

Situation # 2

Waggonerville, a small town in Arizona with a population of about 5,000 people,is located in a large canyon. Five years ago, a copper refinery was built and began operating in Waggonerville. In the process of smelting the copper ore, the refinery pours large quantities of smoke into the air. Since the town and refinery are located in a canyon, the smoke is not readily dispersed by the wind. While checking hospital records, a local doctor notices that respiratory ailments have increased 250% during the five year period that the refinery has been in operation.

Suggested Responses

Conclusions: A copper refinery has been in operation for five years in the town of Waggonerville.

The smoke from the refinery is not readily dispersed by the wind.

Respiratory ailments have increased 250% since the refinery began operation.

Inference: There is a cause and effect relationship between the refinery operation and the increased respiratory ailments.

Exercise IV-3 (p. 114) focuses on the parameters necessary for making recommendations. **A recommendation is a piece of advice, given to a person or persons, concerning some particular action or problem.** It is important for students to realize that **all recommendations which are made must be consistent with the data collected.** The teacher should not hesitate to ask students to defend recommendations they make whether on the basis of data given in the exercise, or on data they collect in their own investigations.

In **Exercise IV-4 (pp. 115-117)**, the student is asked to generate one conclusion and one inference that is consistent with the same data presented in two different ways. The purpose of this exercise is to point out that the method for presenting data which an investigator chooses affects his/her communication and interpretation of those data. Pros and cons of presenting data

graphically and/or descriptively are presented in the paragraphs following the exercise. Possible responses to this exercise are provided below.

Conclusions which may be drawn from both sets of data:

1. Browse production in a 5-year old hardwood forest may be 400 Kg per acre per year, whereas in a 35-year old forest browse production may be only 50 Kg per acre per year.

2. Younger hardwood forests produce more browse than older forests.

Inferences that may be drawn from both sets of data:

1. A young hardwood forest will support a larger deer population than an older hardwood forest covering the same amount of area.

2. As trees grow taller, browse production in a hardwood forest decreases.

Exercises IV-5 and **IV-6 (pp. 118-120)** ask the student to graphically plot quantitative data concerning the Kaibab deer population and to draw a conclusion on the basis of those data. Subsequently, additional information is presented to the students, whereupon he/she is asked to make an appropriate inference and an appropriate recommendation.

A valid conclusion which might be formulated from the data:

The deer population of the Kaibab plateau increased from 6,000 in 1907 to a maximum of 100,000 in 1923, then decreased steadily to 9,000 in 1938.

An appropriate inference might be:

The deer population initially increased because the natural enemies of the deer such as the coyote and mountains were killed off.

Possible recommendations would be:

1. Laws prohibiting the killing of natural enemies of the deer, such as coyote and mountain lion, should be enacted and enforced.

2. Hunting of both does and bucks should be permitted in those areas where natural predators have been removed or severely reduced in population.

Exercise IV-7 (p. 120-122) provides students with additional opportunities to apply their skills in interpreting data, formulating conclusions, inferences and recommendations. Students are presented with a research question related to the continuation of government-sponsored coyote control programs in the western states. They are also given tabular data regarding the stomach contents of 1,600 coyotes, and a prose description of the food categories used in the data table. Students are then asked to generate a conclusion which summarizes the coyote diet, an inference related to the conclusion and the research question, and a recommendation about the continuation of coyote control program which is consistent with their findings. Appropriate responses might include those below.

Conclusion: On the basis of percentage of stomach contents, food types eaten most frequently by coyotes in Kansas are rabbits, followed by carrion; food types eaten some of the time are poultry and wild birds, and rodents; food types that are rarely eaten are fruits, grains, insects, and snakes. Fresh livestock appears to make up only a small portion of the diet of Kansas coyotes.

Inferences appropriate to the conclusion and the research question [**Note**: Both inferences convey the same intent, although they are stated differently.]:
1. Based on the analysis of the stomach contents of 1,600 Kansas coyotes, decreases in livestock populations in Kansas cannot be attributed to predation by coyotes.
2. Kansas coyotes feed primarily on wild animals, carrion and vegetation, rather than on domestic livestock.

A recommendation that is consistent with the findings:
Government-sponsored coyote control programs in Kansas should be discontinued. [**Note**: The instructor will notice that both this recommendation and the one which follow reflect a pro-ecological view. Even though they are consistent with the data, they do indicate a particular value perspective. Other individuals with other value perspectives might generate different recommendations which are not inconsistent with the data as presented.]

In Exercise IV-8 (p. 123), the student is given additional information about the use of 1080 for coyote control, and asked to generate a second recommendation regarding coyote control programs in light of this new information.

An appropriate recommendation regarding 1080 might be: Use of the poison, 1080, should be banned in government-sponsored coyote control programs in Kansas.

Instructors may wish to allow students to explain why this recommendation might be considered an appropriate one. Primary reasons include the conclusion regarding the normal components of the coyote diet (Exercise IV-7), and the descriptive data regarding the poisoning of animals other than coyotes (p. 120).

Exercise IV-9 (p. 123) requires the students to determine if the data regarding coyote diet and the effects of 1080 are sufficient to directly answer the research question. The most appropriate answer is no, **the data do not directly answer the research question as posed.** None of the data directly relate to the "extent to which the government coyote control program should be continued." The data presented **indirectly** build a case for the reduction, or possible elimination, of the program on the basis of ecological data (normal coyote diet), and on the data related to the safety of wild and domestic animals (accidental 1080 poisoning) However, those data are limited to Kansas only. **In order to answer the research question directly, additional information will be needed** regarding some, if not all, of the following variables: (1) actual number of livestock killed yearly, (2) actual causes of livestock deaths (e.g., parasites, disease, poisoning, coyotes, other predators), (3) economic losses to ranchers due to livestock deaths, and (4) cost to maintain coyote control program. Similarly, those data must be collected for the entire western region, rather than only Kansas. This last idea is developed further in the next exercise.

Exercise IV-10 (p. 123) introduces the students to the concept of **generalizability of data.** The instructor should be sure that students realize that the conclusions, inferences, and recommendations they have made in Exercises 7-10 are **based on data from Kansas,** and therefore are **valid to only Kansas** and cannot be generalized to other states. Students often wish to extend the results of their data collection and interpretation far beyond the population or region on which the data were collected. Some students also tend to overgeneralize when doing their autonomous research. (Module V). Exercise IV-10 is included to teach the limits of generalizability and, hopefully, to reduce the frequency of overgeneralizability on the part of the students.

Exercise IV-11 (pp. 123-127) is a final experience in interpreting data, drawing conclusions, formulating inferences, and making recommendations. Students interpret fictitious opinionnaire data regarding littering. The instructor will note that the exercise is broken down into two sections. The first section examines only data from Question 1, and the second examines data from Question 5. This instructional sequence has been organized in this way in order to give students additional practice in data interpretation. In actual research practice, the data from the responses to all the opinionnaire questions would usually be interpreted as a whole, rather than on a question by question basis. The coyote diet data (both tabular and descriptive) from Exercise IV-7 is a good example of this holistic approach.

After the students have responded to the various tasks in the exercise, the instructor may wish to divide the class into small groups and assign the various tasks to different groups. Students can the report their conclusions, inferences, and recommendations to their classmates, and the entire class can participate in critiquing the responses of the small groups. Sample responses for the tasks in Exercise IV-11 follow.

Question 1: Do you consider littering of public and/or private property to be a problem in this community?

Conclusion:

More adults than junior high students believed that littering was a community problem.

Inferences:

1. Individuals of differing ages view the problem of littering differently, i.e., they have differing beliefs about littering.
2. Adults are more aware of a littered community environment than are junior high school students.
3. Junior high school students are more tolerant of a littered community than are adults.
4. Junior high school students do not see the relationship between human activity and the littering problem to the extent that adults do.

There are probably many more plausible inferences. The situation allows for more than one inference, since two distinct age groups were the sources of the opinions. Therefore, inferences can be made for each age group.

Recommendation

None can be made at this point. Since students have only the data from Question 1 at their disposal, recommendations are difficult to make. Question 1 data are inconclusive in terms of a recommendation, given that there was not complete agreement in either group regarding the existence or nonexistence of a community littering problem. Also, no data were collected by way of a survey of the actual amount of litter in the community. Nor were the respondents asked to state the basis for their yes or no responses. The best recommendation at this point would be to collect more data on each of the two situations stated above, i.e., Is there a littering problem in

the community? What types of litter exist and where are they located? What were the respondents' reasons for believing that there was or was not a litter problem?

Exercise IV-11 may elicit a certain degree of frustration on the part of the students, yet the lesson serves as a valuable learning device which reflects the essence of research - that being the idea that **often the results of research give rise to further questions and to the necessity for further research rather than providing clear cut answers.**

Question 5: What age person do you believe is most responsible for the littering?

Conclusion

Junior high school students believe that all age groups are equally responsible for littering. Adults believe that students of junior-senior high age are most responsible for the littering, and that college aged individuals are the second age group most responsible for littering.

Inferences:

1. Adults have observed littering taking place and can accurately identify the individuals who are responsible.

2. Junior high school students have observed the littering taking place and can accurately identify the individuals who are responsible.

3. Junior high school students do not hold biased opinions toward any particular age group as the source of littering.

4. Adults hold biased opinions toward junior and senior high aged students, as well as college aged students, as the source of littering.

5. Junior high aged students are not aware of who actually litters.

6. Adults are not aware of who is actually littering.

Recommendations:

1. A survey of areas of the community in which litter occurs should be undertaken to determine who is responsible for the littering. This survey should be undertaken in such a way that the litterers do not realize they are being observed.

2. If the results of the above survey indicate that junior-senior high school aged students are responsible for most of the littering, an anti-litter educational program should be instituted within the junior and senior high schools of the community.

3. If the results of the above survey indicate that all age groups litter, an anti-litter educational campaign should be instituted for the entire community.

4. Various other recommendations might follow from the results of the survey completed in Recommendation #1, including: a) increasing the number of refuse containers in areas where littering occurs, and b) passing and enforcing a litter law in the community.

Regardless of the recommendations made by students, the instructor should accept as valid those recommendations that were **consistent** with the conclusions and inferences on which the recommendations were based.

The above recommendations are based mostly on the results of a suggested littering survey, rather than on the opinionnaire. Often one will find it difficult to make sound recommendations from opinionnaire data. It may then be necessary to use a survey to corroborate or refute the opinions of the sample. This is a most important concept for students. They should be made to realize that, in many cases, more than one form of investigation technique must be used in order to obtain data from which valid conclusions, inferences, and recommendations can be made.

If, in Exercise IV-11, the students can correctly state a conclusion, an inference, and a recommendation, it is an indication that appropriate conceptualization has taken place, and that the students can apply those skills to new situations. If this conceptualization has not taken place, the instructor is encouraged to have the students collect a set of data and to engage in more practice drawing conclusions, formulating inferences, and making recommendations from those data.

MODULE V

INVESTIGATING AN ENVIRONMENTAL ISSUE

Overview

Module V is an autonomous student investigation of an environmental issue. It is the culmination of what the students learned in Modules I-IV. The activities provided within Module V are designed to help provide definition and structure to the investigation task. There are no objectives or specific directions since students are engaged in autonomous research within a contract setting. The student's task is to choose a topic to investigate, formulate a research question(s), establish the techniques necessary to collect data which will answer the research question, and carry out the research. The teacher's tasks are to (1) establish the guidelines for the investigation and (2) to serve as a facilitator in the investigation process.

The authors suggest that the research in which the student engages should serve as an evaluation of whether he/she has the skills and can apply those skills to an issue situation. It is not a matter of his choice of research strategies as much as it is whether he can apply the skills in the research strategy chosen.

Some instructors may be quick to criticize the authors if the students have problems while engaged in autonomous research. The writers would like to point out very specifically that they have not guaranteed that the students would be able to function without guidance and input from the teacher. Neither do they guarantee that the student will be able to inductively transfer his/her skills from training modules to the autonomous module. Indeed, it is hoped that he/she can, but research points out clearly that transfer takes place most appropriately when it (transfer) is taught. In other words, it may well be appropriate for the instructor to help the student see how acquired skills can be applied to the new and unique situation.

The writers will guarantee, however, that students who have successfully completed the first four modules will succeed in autonomous research far better than students without modular training. This, of course, assumes that the instructor serves as a consultant and "research associate" to the student. Certainly, the instructor need not engage personally in the research, but the student must feel that the instructor perceives the importance and excitement in the research being conducted.

Suggestions for Teaching Module V

There are several teacher actions critical for the success of Module V. They include . . . (1) defining and structuring the investigation assignment, (2) facilitating student planning of the investigation, (3) monitoring student progress during the course of the investigation, and (4) evaluating the issue investigation.

Defining the Assignment. The structure of the investigation assignment for Module V is left to the teacher. There are a number of options for the teacher in structuring the investigation task. The authors assume that the teacher is much more knowledgeable than they about the needs and abilities of his/her students. Similarly, the teacher is seen as best able to judge curricular and community constraints in his/her setting. In Module V, therefore, the authors have presented suggestions and models of an appropriate investigation model. These suggestions are intended to provide a conceptual framework of the investigation assignment for the students. Specific decisions within that framework are left to the teacher.

A Model for Issue Investigation (p. 130) specifies the steps involved in planning, conducting, and reporting an environmental issue investigation. These same components are also graphically displayed on page 131. Again, whether or not individual students will incorporate each of those steps is a decision to be shaped by the instructor, and by the nature the issue under investigation by particular students. This listing does provide an example of elements which can be incorporated into an issue investigation, and sets up a model for such an undertaking.

The purpose of **Exercise V-1 (pp. 132-133)** is to communicate to students the key criteria of the investigation assignment. This activity divides the assignment into a number of sections, including student organization, the type of database to be used, the final product, the investigation timetable, style considerations, and special directions and procedures. The teacher should consider each of the sections carefully before deciding the final criteria for the assignment, and should clearly communicate those criteria to students. Each decision will, to some extent, impact on student behavior as well as the final product. Each of the questions presented in Activity V-1 will be considered below.

1. **How will you organize to investigate an issue** - individually, in pairs, in small groups?

The authors prefer individual investigations. This insures that each student must apply the skills learned in Modules I-IV and maximizes the student's cognitive and affective commitment necessary to complete the assignment. However, there are a number of valid reasons to organize students into pairs or even larger groups. Teams may be structured so that

team members complement each other's strengths. Fewer investigation topics are needed. Fewer secondary resources and other resources are needed. These positive aspects must be compared against potential grouping problems, e.g., a student team adopting a "social" rather than a "task-oriented" attitude toward the investigation assignment, students moving away from the school district during the investigation, problems associated with assigning individual student grades on the basis of group work, etc.

2. **What kind of data should be collected** - primary, secondary (print material, interviews, letters for information), or some combination of the above?

The authors recommend that students collect both primary and secondary data in their investigations. This criteria insures the use of two discrete sets of skills, one dealing with primary data and the other dealing with secondary data. However, teachers without access to adequate libraries may choose to use only primary data. Those teachers with limited time may choose to use only secondary source data. Some teachers have required that students write letters for information and/or interview resource persons as a part of their investigations. However, both of these methods contain, to an extent, "unknown" factors about the utility of the response. Students should be encouraged to use these methods but not rely on them solely.

3. **What are the components of the final product?**

A decision must be made concerning the nature of the final product and its components. The authors prefer both a written investigation report and an oral presentation of that investigation report. But, again, that decision rests with the teacher. Obviously, an autonomous investigation should have structure to bring it together. That structure might be oral, written, or both. A written report presents the student (and parents and peers) with solid evidence of his/her effort and achievement, and offers a student product which can be evaluated at the teacher's convenience. The oral report, on the other hand, has a potent "multiplier" effect, as it serves to familiarize class members with a wide array of environmental issues. In that stead, it may heighten the generalizability of each individual's experience far beyond the single issue which he/she chose to investigate. The oral report is also a vehicle for the recognition of each student as an "expert" on his/her chosen issue, and may tend to promote a further commitment to that issue as the student publicly affirms his/her interest in and commitment to the issue. The ideal situation would require both written and oral reports.

The following sections were offered as components of either an oral or written product: a purpose, plan, review of literature, results, findings, and a bibliography. These sections represent the traditional components of research literature in which data were compiled from both primary and secondary sources. They are certainly not the only possibilities.

4. **What is the due date** for the final product? Are there due dates for various sections of the

investigation? If so, what are they?

Time estimates for Module V are very difficult to make since the student is not only in an individualized learning situation but also on a self-paced schedule (time and teacher permitting). Many variables impinge on the speed at which investigations can be completed. Students may write away for information. Sources are not always prompt in replying. Students cannot get instant interviews with governmental or other professional people. A needed book may be temporarily out. Producing a valid questionnaire takes time. A horde of seemingly impeding problems can plague progress. This is part of the scene and the instructor should anticipate some frustration.

Some students may finish projects and have reports completed within three to four weeks. Other students may require five to eight weeks. A number of strategies can be used to "take up the slack". A student finishing early may be eager to tackle another problem, or, perhaps, take some sort of action based on the findings of his research. The teacher may choose to bring the class together one day per week to permit the discussion of problems and/or progress. Teachers may wish to schedule oral reports for students having answered their research questions. In fact, teachers may wish to initiate Module VI on selected days of the week. Of course, the teacher must not evaluate the student on how long it takes him to complete his project (unless, of course, the student's motivation to reach closure is low).

5. **In what style should the final report be produced?**

Teachers should be prepared for many questions about report length, the number of bibliographic citations, titles and subtitles, etc. Many teachers who have been successful with students' investigation reports have worked closely with the language arts teacher on both the written and oral products. Often, the language arts teachers have considerable experience dealing with these types of student products. This experience might lead to the most productive format and style suggestions for the students. In fact, including the language arts teacher in the planning, writing, and evaluation of the investigation reports may be of considerable assistance for both teachers and students. The authors' experiences with science-language arts teacher teams indicate that the combining of instructional skills usually leads to superior student products.

6. **Are there any other special directions and procedures for the investigation?**

Investigations sometimes lead to a number of requests. These might include the use of school stationery and stamps, the use of the telephone, the duplication of instruments, photocopying secondary source information, student passes to the computer lab, using other students as sample subjects, and a multitude of other possibilities. Often the answers to these questions are dependent upon individual teacher and/or school policies. It is simply in the students' and teacher's best interest to think through these kind of possibilities.

Facilitating Student Planning. Hopefully, students now understand what is expected of them. But the issue investigation is a huge task, and many students might have problems getting started. The key to a high-quality, successful issue investigation is thorough, thoughtful planning. Teachers may elect to use a technique which separates the investigation planning into a number of smaller steps. A worksheet based on this concept has been devised and has been included here. [A similar, but not identical, worksheet is available for use in Module III of the student's manual.]

Planning an Environmental Issue Investigation

1. What **environmental issue or condition** have you chosen to investigate?

2. What are the **research questions** related to this issue which you want to have answered?

3. Exactly what **information** (data) will you need to collect? Identify the variables in your research questions to determine some of these data (both secondary and primary information should be considered). Also, think about what demographic data (e.g., age, occupation, gender, etc.) will be collected from survey respondents.

4. What, if any, are the important **words, terms, phrases, or units** that need to be defined?

5. Is your investigation to include a . . . ____ survey ____ questionnaire ____ opinionnaire?

6. In what **geographic area** will the data collection take place?

7. If there is to be an opinionnaire, what are the exact **beliefs and/or opinions** being investigated?

8. If there is to be a questionnaire or opinionnaire . . .

   A. What is the exact **population** from which the data are to be collected?

   B. How **large** do you think the **sample** will need to be to represent the entire population?

   C. How will you go about **selecting your sample**?

   D. Which **data collection techniques** will you use (e.g., telephone, survey, mail survey, personal interview, etc.)?

9. What are the exact **procedures** necessary to collect data with this survey? That is, who will collect the data? How will it be recorded? During what time periods will it be collected?

10. Think about the development of your survey instrument in terms of . .

A. What, if any, **special procedures** (length, reading level, etc.) are most appropriate for your population?

B. What can be done to improve the clarity of the instrument's directions and procedures?

C. What can done to improve the likelihood of responses from the sample (stamped return envelopes, introductory letters, etc.)?

11. How can the collected data be recorded and organized into a **Data Summary Sheet**? (Sample Summary Sheets were presented in Module III.)

12. How can you **pilot** your survey instrument (make a trial run) with a few sample respondents?

Exercise V-2 (p. 134) sets up a monitoring system for the students and the teacher. The importance of the teacher during the entire investigation process cannot be underestimated. The investigation assignment, by its very nature, is an autonomous, self-paced process. The quality of the final student product can be enhanced significantly by teacher input at critical points. It is, for example, essential that the teacher evaluate the research questions posed by the students. Although they have learned the necessary elements of the research question, students often tend not to delimit the question to parameters they can handle. Often their questions are too broad or may even be unanswerable.

One method of monitoring student progress is to use a **task checklist.** The task checklist identifies critical stages of the investigation process and forces the student to have each stage approved. It provides a mechanism for teacher quality control. During the investigation period, the teacher will act as a consultant, resource person, possibly a liaison between school and community, and most of all an encouraging supporter of students. The role is a rigorous one demanding energy and attention. However, the payoff of this expenditure is well worth the effort.

It has been the authors' experience that the majority of students have been excited and anxious to engage in autonomous research. There have been a few instances where an individual student has refused to undertake a research project. In those cases, the teacher has chosen not to force the student to do research. Appropriate academic work has been substituted for that student.

Evaluating the Student Investigation. Module V is planned and structured around a contractual agreement with the students (p. 135). The contract is the basis for student commitment and also acts as an evaluation framework for the teacher. In the student edition, the authors chose not to place actual numerical values in the "Possible Points" column for each of the project criteria. This is a decision for the teacher to make. However, the "Criteria" portion of the contract is reproduced below, along with the point values that the authors have used while teaching the modules. The values are merely suggestive, but do provide an example of weightings that have been used on the various criteria.

Criteria	Possible Points
Quality of the research question(s)	10
Techniques used in the investigation	20
Seriousness of approach to research	10
Quality of data collected	20
Accuracy of conclusions	20
Quality of inferences	20
Accuracy and organization of the final report	25
Class presentation	25
Grand Total	150

All evaluation components represented on the contract, except one, directly or indirectly reflect skills developed in the modules. The one not referring to skills on which the student has had at least partial training is that one dealing with the seriousness of the approach to the investigation. The reader will note that this criterion has been given only a 10 point value. The contract itself is probably a better guarantee of performance than this criterion, and if the instructor determines that it should be deleted this should not greatly affect student behavior.

A teacher may be concerned as to why the research question(s) criterion is given only a 10 point value. This is simply because the instructor has already approved the research question and, if it is not worth criterion, the instructor has erred in his/her responsibility to help guide the students toward a workable research strategy.

In terms of the class presentation evaluation component, it is the instructor's prerogative to identify the characteristics or parameters that students should follow in their oral reports. These should be communicated to the students far in advance of the actual presentations. Some guidelines to consider are: clarity of presentation, completeness and accuracy of the report communicated, use of audio and visual aids, effectiveness of communication, etc. The intent of

the oral presentation is to inform the entire class of the issue researched. It can serve as an additional learning activity for the entire class and could serve as a springboard for additional class discussion. Such reports can also serve as topical material for the environmental action module (Module VI).

The Teacher's Role. In the Preface of the Teacher's Guide, the authors addressed the teacher role which appears to be most effective in achieving student success with the modules. The role does call for a modified style on the part of some teachers. It demands a **trusting posture** between teacher and students. Coupled with that trust, moreover, must be a set of high teacher expectations. Research suggests that students tend to achieve to the level of teacher expectations. This being the case, set rational but high quality expectations for your students. If the students have developed the skills addressed in Modules I-IV, they do have the prerequisite abilities to do autonomous research. It is up to the teacher to work with the students in terms of the responsibilities **they** have as independent investigators, e.g., respecting the rights of others, abiding by school rules. It may be helpful to have a class discussion with the students regarding the **rights** that they have as they pursue their research and the **concomitant responsibilities**. There is nothing wrong with making the ground rules clear, but it should be done from a positive standpoint.

During the actual research period, the teacher will act as a consultant, resource person, possibly a liaison between school and community, and most of all, an encouraging supporter of the students. The role is a rigorous one, demanding energy and attention. However, the payoff of this expenditure is well worth the effort.

MODULE VI

ENVIRONMENTAL ACTION STRATEGIES

Overview

In Module VI, students are first introduced to the basic elements of environmental action. After defining positive, negative and passive action, students propose examples of each type, and defend their choices. They are confronted with the difficulty in classifying actions, due to the divergence of opinions on personal rights and the effects of particular actions on the environment. Students are then introduced, in detail, to specific modes of action, i.e., persuasion, consumerism, political action, and ecomanagement. A discussion of the effects of individual and group actions, and of the categories of group actions follows. Students are presented with a list of fourteen criteria which comprise a decision making model relative to responsible citizenship action in the environmental realm, and which should be considered before undertaking an environmental action. Further, they apply these criteria to a specific example of environmental action. Lastly, the students are given an opportunity to apply all of the action skills and knowledge as they develop their own plan for action concerning an environmental issue of their choice. They identify and summarize the issue, identify and evaluate possible actions, apply the action analysis criteria, and make a final recommendation concerning action on their issue. (Specific objectives for Module VI can be found on pages 140-141 of the Student Module).

Suggestions for Teaching Module VI

Module VI introduces students to most of the basic citizenship strategies inherent in environmental action. Up to this point in the modules, the students have been engaged in activities focused on identifying and analyzing environmental issues, and on methods of securing information regarding those issues. This module exposes them to the array of actions that they might use to help bring about the resolution of those issues. The advantages and disadvantages of persuasion, consumerism, political action, and ecomanagement are discussed and students are given the opportunity to engage in surrogate activities involving each of these action modes. Although legal action is mentioned along with the other citizen actions, there is no detailed discussion of this particular mode of action.. Legal action was purposefully not covered in the modules, since it is, by and large, a strategy not at the immediate disposal of junior high age students.

Throughout this module, students are presented with examples of both positive and negative behaviors in response to environmental degradation. Both types of behaviors should

be explored, and the ramifications and responsibilities of such behaviors should be discussed, weighed, accepted, or rejected. This module is geared to challenge the students' abilities of analysis, synthesis, and evaluation rather than basic recall and memorization.

Module VI offers suggestions for real environmental action projects and it should be used with that end in mind. The authors recognize the tremendous significance of students being involved in environmental action projects, and recommend this procedure as the culminating module activity. They also firmly believe that **it is both unethical and unfair to demand that students take citizen action.** However, students should be capable of taking responsible citizen action as a result of their interaction with the information in Module VI. Moreover, it is hoped that they would be willing to take such action by virtue of the information they gained from their own issue investigations. It is also hoped that instructors who are involved in teaching this curriculum will support and assist the specific action decisions made by their students. Environmental awareness without subsequent positive action is of little personal or societal value.

As with the previous modules, the authors have attempted to describe each major action mode, and to present general guidelines for each action strategy. However, by virtue of the nature of the material, the student has not always been presented with an opportunity to fully apply the strategy in an actual situation. It is the intent of the authors that instructors using this module will assess their students and will develop further models and application opportunities as the needs of their students seem to dictate.

American Bison Photo (p. 141). Although the photograph of the American bison does not carry a caption, it can be pointed out to the students that this animal's survival is a function of environmental action which was taken after 1900. The only reason that the bison survives today is because a handful of concerned Americans were willing to use their skill and time to establish a number of refuges for the "buffalo". You might suggest that this dramatic story be researched and reported on in class.

Exercise VI-1 (pp. 141-142) presents students with a variety of environmental actions, and asks students to identify the common elements in the actions. Most students will decide that the common element of the described actions rests in their being negative or detrimental toward environmental quality. Not all students may see this, due to disagreement about their personal rights and the effects of specific actions on the environment.

Exercise VI-2 (p. 143) involves the students in making judgments about specific environmental actions. It is recommended that the instructor engage students in a discussion of

their rationales concerning negative, positive, and/or neutral stances toward each behavior. The discussion will probably reveal differing values. This is to be expected, for within these differences lie the crux and origin of environmental issues and diversity of behaviors. Although this module contains no values clarification activities, per se, students must apply their values in evaluating these action situations. Thus, it is important to recall the parameters for a "value fair atmosphere" established in Module I. Similarly, every effort must be made to bring students to examine the ecological consequences of their particular value stances. Even so, there will most certainly be students who do not see the negative ramifications of certain behaviors. Hopefully, these insights will come in time as they receive further exposure to decision-making regarding environmental issues.

The authors exhibit their own values in the classification of actions in Exercise VI-2. Items 1 to 6 are all considered to be **negative actions.** The responses to Items 3 and 4 should elicit discussion in terms of personal rights versus environmental degradation. Item 5 can lead to a discussion of the national problem of solid waste buildup, removal, disposal sites, costs, etc. The topic of landlords' services to rental property and renter responsibilities to his home or business are also pertinent here. In Item 6, the teacher may have to point out the problem caused by the lack of disintegration of aluminum and the subsequent effects this can have on the flora and fauna of the lake. Item 6 might also provoke discussion related to aesthetic concerns with littering, and to the finite supply of aluminum ore.

Item 7 receives a **positive** classification. Here the defense rests in the long term benefits of composting in order to enrich the soil. The odor is a short term nuisance which can be circumvented by proper construction of the compost pile. Additionally, the application of lime usually deters odors, accelerates decomposition, and adds mineral nutrients to the organic material.

The **answers will vary** to items 8, 9, and 10. In Item 8, students might point out the relationship between the increased gasoline consumption of inefficient pollution devices and the depletion of fossil fuel reserves. The threat of increased air pollution is a counter argument. Each is a legitimate position - a matter of values. In Item 9, it is hoped that students will point out the double-edged sword of excessive water use in contrast to the electricity consumed to keep the water cool. Item 10 will probably elicit a great deal of discussion. The advantages of zero population growth and its effect on food and water supplies, available space, psychological stress, etc. can be compared to religious, social and cultural values.

In many of the above items, especially 8, 9, and 10, there is little concrete knowledge (empirical evidence) from which values can be developed. It should be pointed out to students

that, in many cases, their decisions should be tentative until more knowledge is available. As knowledge is gained, individuals can then behave consistently with desirable environmental goals.

The authors recommend that rational and disciplined arguments should be permitted in the classroom. Further, after the students are familiar with the Action Analysis Criteria it is suggested that you return to this classification activity and apply the criteria to each situation. In this way, students may evaluate the actions in a new light.

The anecdote entitled **One Citizen's Action: Negative or Positive? (VI-3, p. 144-145)** will probably elicit both positive and negative responses from students. It presents fertile ground for the instructor to emphasize the divergence of opinions and actions due to varying human values. The authors suggest that this activity be used in several stages. After reading the anecdote, the individual student should first consider his/her beliefs and values in evaluating the tree-spiking action. Small groups might then be formed to compare students' assessments and to predict the reactions of citizen groups and public officials to the spiking. Lastly, a large group discussion can be held to describe the divergence of values found within the students (if such exists), and to infer why members of citizen groups and public officials might react as they did.

You and Action: Important Ideas (p. 146) describes a number of assumptions which the authors made in conceptualizing this set of modules. As such they probably comprise a fairly accurate description of the philosophy which underlies this program. It is suggested that students read these carefully and be permitted to discuss these assumptions and the associated implications. These assumptions acknowledge the abilities which students have developed and exhibit a respect for their decisions. At the same time, these assumptions also carry an expectation that students will behave responsibly in environmental matters.

The **Environmental Action Model (pp. 147-152)** is presented as an operationalization of the ultimate goal of environmental literacy - that of overt, positive environmental action. The model contains three major components. The first component is a **categorization of the major action modes (pp. 147)**. These modes are persuasion, consumerism, political action, legal action and ecomanagement. All specific environmental actions can be classified under one of these major modes. The mode of legal action is mentioned in the description of action methods, but is not elaborated on further. The authors have elected not to present the students with instruction on legal action because they feel that middle school students would not be able to successfully accomplish legal action at this point in their lives.

The second component of the Action Model is the identification of the **levels at which**

action takes place (pp. 148-149). Action may be taken by an individual or by groups of individuals at various geographic levels, i.e., local, county, state, national, international. The merit of establishing levels of action lies in the concept that **the scope of concern and the scope of effectiveness of actions usually increases as these actions are taken by groups at higher organizational levels.** It is not the intent of this section to imply that actions should only take place at high levels of organizational structure. Actions should and do take place at all levels. The model should serve only as an guide to analyze the scope of concern and effectiveness as specific actions are considered for particular environmental actions. For example, an effective anti-littering campaign might be accomplished at the community level, whereas a campaign for the protection of an endangered plant species might necessitate action at a regional or state level.

The third component of the Action Model is the establishment of fourteen **action analysis criteria (pp. 150-152).** These criteria are appropriate for evaluating anticipated actions and should be applied by an individual to an environmental action prior to his/her taking that action. The answers to these questions serve as important guidelines which aid in determining the most appropriate action mode to take. In essence, **these criteria comprise a decision making model which incorporates both ecological and social consequences into the final decision.** In discussing the application of these criteria with students, it is important to stress that any action taken should be the result of an ethical, ecologically sound decision.

Exercises VI-4 and VI-5 (pp. 150-154) engage the students in establishing criteria for environmental decision making, and in applying those criteria to a specific environmental action strategy. In Exercise VI-4, the students should compare their own guidelines to the list of criteria posed on **pp. 150-152.** If new and useful criteria come out of his activity, they should be added to the fourteen found in the module. Exercise VI-5 asks the students to assume the role of the tree-spiker, and to apply the action analysis criteria to that anticipated action. This is excellent as either an individual or small group activity. It is presumed that students will decide not to proceed with spiking trees. Such an action would not be ethical, and it would have negative legal and social consequences. It might prove interesting to explore appropriate (and more effective) alternative actions that a concerned citizen might have undertaken.

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Note: Tree-spiking, an illegal act, might be considered civil disobedience by some. If the teacher feels that it is appropriate, this could serve as a place to introduce the idea of **civil disobedience**. Although civil disobedience is part of American tradition, the authors have chosen not to include it within the categories of action available to students. Why is this so? Simply because **it appears wise to teach students to work within the system to bring about sound solutions to issues.** The decision making model (the action analysis criteria) is designed so that students will consider the legal and social consequences of actions. The intent of this model is to develop the capacity for responsible citizen action in students.

Action Method I - Persuasion (pp. 154-162). Persuasion may exist alone as a means of bringing about a solution to an issue. More often, however, the techniques of persuasive action play a role in other action modes. Because, it can be so widely used, persuasion is the first action discussed in detail. Persuasive actions are classified as either logical, emotional, or coercive. The characteristics of logical and emotional appeals are described, along with the relative advantages and disadvantages of each method. It is critically important for students to understand that, **since persuasion attempts to convince others to behave in a certain way, care must be taken that the consequences of that behavior are not environmentally detrimental.** Although coercion is considered to be a tactic of force rather than true persuasion, it is mentioned in Module VI because it is a technique used by environmentalists (usually in a legal context) to assure that positive action is taken. Coercion in the form of threats, intimidation, violence, etc. is both dangerous and unethical. It is also ineffective, once the external force has been removed. Persuasion is most effective when the techniques used bring about an internalized behavior change.

Persuasion strategies can function at three levels within an individual: **awareness, understanding, and valuing.** These levels are usually viewed in a hierarchical arrangement. It appears that awareness is an initial and sometimes superficial recognition that a problem exists, and that understanding requires additional information and a more thorough conceptualization of the implications of the issue. Valuing, on the other hand, entails an internalization process which results in behavior change, i.e., 1) public affirmation of a position related to the issue, 2) "prizing" a particular position, or the consequences of a particular position and, 3) choosing to consistently take action in support of that position. Although all three of these levels are important and related to each other, for a persuasive technique to be ultimately effective it must convince individuals to attain the valuing level - it must bring about a change in the values of the individuals so that they prize and choose to take action.

Eutrophication is discussed in the student text and illustrated with a photo on **pp. 159-160**. It is important that students understand that eutrophication is a normal and natural aging process which takes place in bodies of water. Eutrophication becomes an environmental problem when an overload of nutrients increases the normal rate of the aging process. Nutrients such as phosphates and nitrates can then contribute to excessive plant growth. Eventually those large numbers of water plants die, and decay. The decomposition process for the large number of plants demands a great deal of oxygen, resulting in oxygen depletion of the water. If the oxygen level gets so low that aquatic animals can no longer survive, the situation is further complicated by the death of populations of animals. This, of course, leads to more decay, even lower oxygen levels, etc., and a critical aquatic situation.

The guidelines for persuasive action (p. 161) should be emphasized and discussed with students. Attention to these guidelines will promote the effectiveness of persuasive actions. The fourteen action analysis criteria listed on pp. 145-147 may yield further guidelines which could be added to those presented here in the text.

The discussion of the **methods of persuasion (pp. 154-157)** presents a brief overview of some of those methods. Further activities (practice and/or application) in persuasive action techniques are left to the discretion of the instructor. Some suggestions follow.

1. Students can identify the types of persuasive approaches (logical, emotional) used in television and radio commercials, newspaper and magazine advertisements, etc. Identification of the value positions depicted in each would also be valuable.

2. Students can prepare persuasive actions incorporating a method of their own choosing. Two forms of the action should be prepared, the first one using a logical approach, and the second representing an emotional approach. Additionally, the students may wish to combine the two approaches.

3. Students can prepare a persuasive letter for a local newspaper. The topic should be of interest to the student, and the letter should attempt to convince the public to respond to an issue of local concern. An additional activity might be to ask the student to identify the level(s) of persuasive strategy (awareness, understanding, valuing) utilized in the letter. An adaptation of this activity might require students to prepare a letter for local, state, or national officials. [**Note**: These activities are for practice purposes only. The authors maintain

that is highly unethical for the instructor to require the students to mail the letter(s) out. That action should be an autonomous one, freely undertaken by the student, acting independently. However, there is absolutely nothing wrong with the instructor encouraging the posting of the letter(s), providing school stationery, postage stamps, etc.]

4. An activity which includes a debate strategy can also be quite powerful. The instructor may need to model appropriate behaviors here since debate, although effective, is not a commonly taught strategy. Some debate questions which offer opposing positions are:

    a. Should predator control measures include the use of cyanide?
    b. Should rural land owners be permitted to subdivide or otherwise destroy productive farm land?
    c. Is abortion an acceptable and effective population control method?
    d. Should controlled alligator hunts be allowed in Louisiana and Florida?
    e. Should automobile pollution control regulations be relaxed in order to conserve fossil fuels?

Exercise VI-6 (p. 162) involves the student in taking another look at the action of the tree-spiker, and analyzing it on the bases of logic, emotion, and coercion. The tree-spiker's approach was certainly not a logical one . . . it is difficult to see logic in an action which "punishes" a timber company by spiking an already-cut tree. However, it might be defended as a **coercive approach**, since it attempted to force the temporary halt of timbering/milling activity. Similarly, the action might be considered an **emotional approach**. As described in the anecdote, the situation was one in which emotions were high, and there was a great deal of resentment toward the Louisiana Pacific Corporation. The action might have been an attempt to rally local citizens against the corporation. Regardless of how the student classifies this approach - his or her defense of the analysis is the most important element. This activity also provides an opportunity to reinforce the use of the guidelines for persuasive action discussed earlier.

Action Method II - Consumer Action (pp. 162-163). Consumer action is an effective method of action for both individuals and groups. The **types of consumer action** include direct and indirect boycotting and consumer conservation. In essence, these consumer actions might be viewed as specialized kinds of persuasive actions. The strategy of **direct boycotting** is pretty clear-cut and, can be quite effective when undertaken by a group of individuals. **Indirect**

boycotting can be more difficult to conceptualize, since it is a persuasive action directed at bringing about a change that is related to a product, but not a change in the product itself. The indirect boycotting of Japanese goods did not eliminate the use of whale oil, but it did influence the manner in which whales were hunted - a manner which could have caused critical and perhaps irreversible damage to certain whale populations if left unchanged.

Module VI identifies **consumer conservation** as a consumer action. In addition to being a persuasive action and a consumer action, conservation might also be considered a form of ecomanagement. Such comparisons by students should not be discouraged. Since ecomanagement also includes many non-consumer oriented tactics, it is treated as a more encompassing action mode, with consumer conservation as a specialized type of ecomanagement.

It bears repeating to stress that the activities described for action practice and application are suggested for the purpose of training. Therefore, the instructor must not require students to follow through on the consumer actions which they generated. However, **every effort should be made to encourage students to carry out their action plans, and support should be provided whenever possible.**

Action Method III - Political Action (pp. 163-164). Political action includes activities such as **voting, campaigning and lobbying**. Each of these specific actions also contain elements of persuasion. If an individual chooses to campaign for political candidates who have environmentally positive records, he/she will utilize persuasive tactics to convince others to vote in a certain way. Political action, then, involves knowing how, when, and where to apply persuasion. **Political action also necessitates taking an active role in the decision making process inherent in the political structure at local, state and national levels.**

This portion of Module VI attempts to familiarize students with the elements of political action. It is not designed to teach students the intricate steps of political action. Therefore, it is left to the instructor to decide whether or not to help students learn about the local and state political structure. If so desired, the procedures involved in law making might be examined so that students are aware of the points in this process where political action can be taken. Such legislative information might be taught by the social studies teacher in a team teaching arrangement. Similarly, the instructor might wish to involve students in following a piece of environmental legislation. This law, act, or policy could be one which is currently in the legislature, one which has already been enacted, or one which was rejected by lawmakers.

In order for students to become successful politically active citizens, they need to be well informed. Public news media (radio, television, newspapers) should be utilized so that **students**

become aware of the environmental values of political candidates and of the important issues currently under consideration by government. Environmental organizations such as the Sierra Club, and the National Wildlife Federation are other important sources of information. A listing of those organizations can be found in Module II.

If students become interested in joining environmental organizations, they need to carefully select the groups in which they become active. **Questions to consider when joining environmental organizations are included below.** Your students may very well develop other questions and should be encouraged to do so.

1. Are the goals of this organization consistent with my environmental values?
2. Are the actions which this organization employs ethical as well as effective?
3. Am I willing to commit myself to the goals and actions of this organization?
4. Of what value will my membership in this organization be to myself and to the group?

Module VI presents no specific activities regarding political action. A number of **activities which might be useful in helping students to develop and apply political action skills** are described below. All would be appropriate for use at this time.

1. Students can develop a set of environmentally appropriate guidelines for voters to use in selecting candidates for which to vote.

2. Students can prepare a list of ways in which every voter can remain informed on the candidates and the issues.

3. Students can evaluate a candidate's past congressional voting record and determine whether the candidate has used an environmental ethic in political decision making.

4. Students can select a specific environmental issue and an appropriate political official, and compose an effective letter urging that specific action be taken.

Action Method IV - Ecomanagement (p. 164). This mode of action involves actual physical manipulation of the environment in order to improve its quality. Ecomanagement projects are direct action, and can also serve as persuasive modeling behaviors for other individuals. As individual students become interested in taking an ecomanagement form of action, they should again assess their action choice by applying the fourteen action analysis

criteria. It is important for students to understand that, **in evaluating proposed ecomanagement activities, the question of ecological consequences should receive careful consideration** (Criteria #7). For example, if students decide to set up a full scale newspaper recycling project, they need to carefully consider the type of collection method which they will use. If they were to use a large truck for door to door collection, the environmental costs from air pollution and fossil fuel consumption might be greater than the environmental gains from recycling the paper.

Student responses to **Exercise VI-7 (p. 165)** will probably vary for each local setting. This list is, of course, not all inclusive. It would be a very good idea, therefore, for the instructor to consider involving his/her students in an **ecomanagement needs assessment** within the community. After a thorough survey of such needs, the students could select an ecomanagement project and again apply the fourteen action analysis criteria to determine the appropriate strategy or strategies to follow in the project. Perhaps several small groups could target the same or similar issues and compare their recommendations. Again, it is hoped that the students would ultimately choose to carry out their action project(s).

Applying Environmental Action Skills (p. 167) presents students with an anecdote describing how **middle school youngsters applied investigation and action skills to a particular environmental issue**. This anecdote also serves to illustrate that few environmental actions are one type of action only. Rather, they are a combination of action modes. This particular example combines political action (sending petitions and letters to politicians, visiting politicians) with both ecomanagement (picking up cans from the road side) and persuasive action (sending bags of can litter and letters to politicians).

In reality, an action plan and the subsequent action will probably be a combination of several action modes. Previous to the section, students have been exposed to the action modes as somewhat separate entities. The instructor should emphasize that **action plans should incorporate those actions which appear to be the most appropriate (and effective) for a specific environmental issue.** As always, the fourteen action analysis criteria should be applied regardless of whether a single mode of action or a strategy which combines several action modes is being considered.

Exercise VI-8 (pp. 168-170) requires that **the student develop an action plan for an issue of his/her choice**. It is recommended that students use the issues which they investigated during the autonomous research component of the modules (Module V). Further, if students wish to work together on action plans (and if the instructor is amenable to that configuration), they should be allowed to do so. It is also important that the instructor establish his/her expectations for the final product and explain the final reporting to the students. The instructor

might prefer that students elaborate somewhat on the sections addressing the summary, evaluation, conclusions, and recommendation for action related to the issue. And lastly, every effort should be made to ensure that students are seriously considering the fourteen action analysis criteria and applying them to the anticipated action(s). Should students desire to implement their action plan(s), careful consideration during this planning stage will go a long way in determining a successful outcome to their efforts.

An ending note to this module seems pertinent. The anecdotes in both Module V and Module VI are true ones. Students can actually conduct thorough issue investigations and carry through with environmental action. Although we, the authors cannot demand that your students take action, we hope that they will autonomously choose to do so. The purpose of this module is to help students develop the knowledge and skills necessary to accomplish the task. In the final analysis, we hope that knowledge of action skills will encourage them to become citizens who are not only environmentally aware and concerned, but who are also environmentally responsible and active.